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Engineering News-Record

Batch boxes on narrow-gage cars deliver aggregate to paving mixer

Advanced Roadbuilding on Georgia's Coastal Highway

Rebuilding a Susquehanna River Toll Bridge in Service

Staff Report on American Water Works Association Convention in San Francisco

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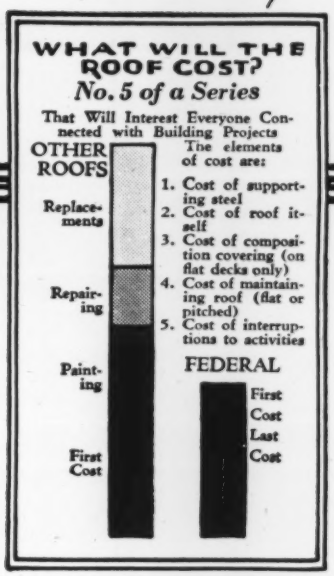
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A Public Loss

COLONEL Charles L. Potter's abrupt removal from the office of president of the Mississippi River Commission is an event to be deplored. It is a public loss. His ability and intimate knowledge of the river, which won him the confidence and support of all, were never so greatly needed as they are in the critical restudy of plans for flood control during the next few months. Congress, realizing the need, with two sharply clashing plans for the work before it, provided as explicitly as is possible that both the Chief of Engineers (General Jadwin) and the president of the Mississippi River Commission (Colonel Potter), who represent the two plans, should be members of its board of review. The public interest obviously required that both, or else neither, should have a place on the board, to the end that personal bias might be eliminated as far as possible. Under any circumstances Colonel Potter was the one man to explain and defend the flood-control plan worked out by the commission. When General Jadwin in his statement to the Congressional committee on the flood-control bill denounced and ridiculed the commission and its plan, it was still more evident that the commission's plan would need a competent and independent defender. A sense of fairness and sportsmanship, moreover, might have led the Chief of Engineers to seek for just such championship of the commission's plan, in order that the technical questions at issue might be most fully tried out. But the answer to the situation is the removal of Colonel Potter, in open defiance of the will expressed by Congress and in flagrant disregard not only of the amenities of the case but also of the plain technical necessities. Under the circumstances the task of the board of review is of gravest difficulty, and its responsibility therefore of especial magnitude. Its members are of undoubted ability, but that alone is not enough. Colonel Potter's retirement, we repeat, is a public loss.

Business as Usual

IN CONSTRUCTION involving inconvenience to the public, the practice not so many years ago was to get the job done and let the public shift for itself. Particularly was this true of highway and bridge construction. Lately modern demands and conditions have wrought some improvement. State highway authorities have taken a broader view of the problem of public relations, and have improved their detour practice and labored for quicker completion of repair projects. That there is room for further improvement is realized by every road user. The incentive of a true cost comparison can accomplish marvels in this direction, as illustrated by the rebuilding of a toll bridge at Harrisburg, described in this issue. Here the contractor's or engineer's convenience was of minor concern. Traffic had to be kept moving without interruption or delay. Every hour that the bridge was out of service had a dollar sign in front of it and a number of ciphers behind. In point of fact, any public project is no less a business proposition than this toll bridge, but unfortunately the loss in dollars is not so easily determined nor of such direct concern to the builders. Only when the necessity for treating every project as a money-making enterprise impresses itself upon the consciousness of engineers and contractors generally can the public expect such service as was given during the Harrisburg bridge reconstruction. In the meantime it can only hope and dream of the time when every bridge and highway job will be tagged with a business-going-on-as-usual-during-alterations sign. There is still a long road to that point.

Credit to Roadbuilders

CONCRETE paving is an art as highly developed as can be found in modern civil engineering. In the mechanization of construction operations, in the quality control of materials and fabrication, in verification tests of finished structure and in the final survey of faults to determine opportunities for improvement, few construction operations surpass it. The work described in this issue of paving the coastal highway in Georgia is typical. The procedure described is not exceptional; the road department that inspired and directed it would be the last to claim any significant departure from well-proved practices, and indeed in some respects practice elsewhere has gone farther in scrutiny and verification of construction processes and finished structure. But the Georgia road work is instructive because of the very fact that it is representative, and on this score it merits particular attention by builders in other fields of engineering construction. They may recognize that in only a few of their concrete works are the control and prosecution of construction generally superior. The roadbuilder deserves this recognition. Rarely does he receive much praise for his services, and his tenure of office is not too secure. His compensation as measured against his responsibilities is absurdly small. And in keeping with this scanty reward, his work has been rather perfunctorily appraised by his brother engineers as not exacting particular technical proficiency. The article in this issue is important, then, in showing that at least in construction proficiency the concrete roadbuilder has little reason to be humble in the face of present knowledge and attainment of the engineering arts.

Typhoid-Free Cities

SEVEN American cities of 100,000 population or larger passed through the year 1927 without a single reported death from typhoid fever. For one of them this is the fourth typhoid-free year since 1918. No other of our larger cities has done better than a single typhoid-free year within the last ten years, but seventeen achieved this latter distinction. These and other figures which, though

less encouraging, are proper causes for congratulation are shown in more detail elsewhere in this issue. As a check on too much pride and exultation, the *Journal* of the American Medical Association, from which the figures are taken, points out that in the year 1924 no less than fifteen of the larger British cities reported no deaths from typhoid. The American record for that year was two cities out of 75 to 80. For restoration of good cheer, even though it must begin by stating a shameful figure, it may be noted that in the last eighteen years the average typhoid death rate per 100,000 population has fallen from 20.58 to 1.96. Why four cities should tail the 1927 list with rates from 12.9 to 16, and why one geographic group should have an average rate of 10.07, deserves consideration from the cities themselves and the states in which they are located. While the causes presumably lie partly if not chiefly in defective sanitation, it seems unlikely that the public water supplies are responsible. In fact, a hasty running over the list, with an eye to low as well as high rates, leads one to conclude that most of the typhoid of 1927 in the 81 cities must have come from some other source than public water supplies, however much the good character of the water may have contributed to the low rates. It is only reasonable to suppose that with the successful attention paid to the purity of the water supplies of nearly all our cities in late years, practically all the typhoid comes from other and as yet uncontrolled sources. This should stimulate rather than relax the care of our water supplies. It should also intensify anti-typhoid measures in other directions until city after city is added to the zero recurrence class.

Micrometer Measurement

A SHAFT installed recently in a hydro-electric plant on the Pacific Coast has a diameter of about 26 in., is 28 ft. 8 in. long, and weighs about 16 tons. It was made in the East by one manufacturer under a subcontract from another manufacturer, who shipped it to the plant of a third manufacturer, where the rotor of the electric generator was pressed to place on the central part of the shaft. The partly assembled unit was then shipped across the continent to a power plant in a remote mountain gorge, where hydraulic turbine runners, made 3,000 miles from where the shaft was forged, were pressed into place on opposite ends of the shaft. In checking up dimensions just before the runners were pressed on, the variations in diameter were found to be less than 0.001 in., a refinement very much greater than that necessary to insure success with the hydraulic press method used in assembling such units. This high degree of accuracy is not purely a scientific matter; it involves elements that make it more of an art than a science. Measurements are made, for example, only in the early part of the day when the least temperature differences between various parts of the unit are likely to obtain; the co-operating manufacturers exchange gage standards which are kept in constant-temperature laboratories, and to reduce the personal equation, all measurements on the job are made by a single individual, on whom is placed sole responsibility for co-ordinating dimensions. A few years ago, before the days of co-operation to obtain these refinements, it was altogether impracticable to expect shops on opposite sides of the continent to work to any such close figures. Under modern methods all this has changed; the art of micrometer measurement is now an essential phase of the manufacture and assembly of hydro-electric units.

Engineering in Government

ENGINEERING is honored in the selection of Herbert Hoover as the candidate of one of the great political parties for the office of chief magistrate of the United States. Hoover was trained as an engineer and practiced the profession throughout his career. He is much more than an engineer, it is true, and beyond doubt his brilliant achievements as organizer, leader and administrator played a decisive part in singling him out as the standard-bearer of his party. Yet in all his work the contribution of his engineering training and career is plain. Dispassionate study of facts, analysis of conditions and careful planning of results mark all that he has done. The engineering methods and habits of mind that won him his fame have also won him the nomination.

The nomination is significant of a changing world. It reflects the long decades of development that have made our time an era of great structures, of widely diffused power, of emancipation of men from manual labor and their endowment with many comforts; an era of annihilation of space, of instant spread of knowledge, and of marvelous knitting together of vast populations into an interdependent family. Government faces new problems in these times, problems which make obvious claim upon an understanding of the technical factors of modern life—not merely of the technique but also of the very nature of the conflicts and relationships which the new engineering arts bring about. Thus it is the necessary logic of evolution that brings the engineer to the fore.

Since the day of George Washington, chosen 140 years ago, not one of our Presidents has possessed the engineering background. Even Washington's leadership was due to qualifications other than those displayed during his surveying and canal-building period. The long line of legislators and jurists who succeeded him gave expression to the dominance of non-engineering activities and schools of thought during that century and more. But now that engineering activities are of major concern, a new temper of mind is in order, and it is fitting that the engineer should be called upon to direct.

In the lesser circles of government the engineer has found recognition before now. We have many mayors who are engineers, and as well a number of governors of states. Both city and state governments have grown with our increasingly mechanized manner of living and we find their most extensive operations to be in the hands of technical officials and boards—such operations as are required by highways, public works, utilities regulation, building control, and sanitation, for example. Where formerly the physical and administrative functions of government were essential and the engineering functions were mere service auxiliaries, today the situation is reversed; the engineering functions are the essentials and administration and taxation are the servants. So also in the government of the nation has the work of the technical bureaus and branches come to overshadow most other activities. The chief problems not only of legislation but also of the executive and judiciary rest on engineering foundations.

What the engineer contributes to the world's thinking is not so much his knowledge as his objective mental attitude and habit of analytical planning. These attributes have heretofore been utilized mainly in the shaping of details, and have been less influential in the formulation of broad policies. But they are no less vital here. Industry long ago realized this truth and applied it by placing engineers at the head of railways, utilities and manu-

facturing enterprises. Political government, managed by less responsive methods, has been slower to learn, but the nomination of Herbert Hoover indicates that it is making progress at last. It is an encouraging prospect; for the world will be better when the controlling decisions in government are based on facts, analysis and prevision, rather than on emotion and prejudice.

A Half-Century of Advance

HALF a century ago relatively few American cities had public water supplies, while practically none of those which had were doing a thing to protect or improve their quality. In 1878 storage and sunlight were the only agents in use to reduce bacteria and color, storage also reducing turbidity, while tastes and odors, hardness, iron and manganese were passed on to the consumer without let or hindrance. Broadly speaking, there was no water treatment until well into the eighties except what was afforded by sedimentation and bleaching in reservoirs. When a better supply was needed, another source was sought, a process which with the meager and empiric knowledge of the day was more or less of a gamble. Protection from the sewage and industrial pollution then becoming rampant was almost unknown, with few laws on the statute book to aid in prevention work, no men or money available for pollution inspection, no body of court decisions to back prosecution of offenders. There were glimmerings of knowledge as to the cause of the sometimes nauseous tastes and odors due to algæ growths in reservoirs, thanks to the early microscopic work of such engineers as Rafter, FitzGerald and Forbes, but what use to make of the little knowledge then accumulated was unknown.

In 1878 to 1888 there was a great awakening, some addition to knowledge of ways and means of protecting and improving water supplies, a start at protective legislation and means for its enforcement, the beginnings of water treatment and the laying of foundations for later knowledge and achievement. The next decade, 1888 to 1898, witnessed much earnest, intelligent study and laid the foundation for the vast achievements of the present century. Mechanical filtration—as first practiced a wedding of coagulation and filtration that was supposed to do away with the necessity of sedimentation even for the most turbid waters—came to the front, but with more commercial exploitation than competent engineering, and subsequently with a ruinous competition. To the credit of the pioneers in mechanical filtration it should be said that with the knowledge of that day nothing but the combination of coagulation and filtration, with the reverse flow for washing the filter sand made possible by a rapid rate, would have coped with the turbid and the colored waters for which mechanical filters were first chiefly used.

As contrasted with the mechanical or rapid filters introduced from the late eighties onward, many of them working under pressure at acre rates up to 100 million gallons per day, many English and some Continental cities were filtering water, through great artificial beds of sand, at rates of some 2 million gallons daily and with laborious hand scraping of the beds, washing and returning of the sand. The centenary of this practice, introduced by one of the London water companies, will come next year. In the fifties filtration was made compulsory for the other London companies supplying river water. Strangely enough, the slow sand or English filter got no footing in America until after rapid or mechanical filtration was well started commercially, although in its infancy technically. Until in the nineties, Poughkeepsie and Hudson, N. Y., were the only cities using slow sand filters, for which they had to thank, or should have thanked, the city of St. Louis, which sent James Kirkwood abroad in the sixties to study and report on filtration. St. Louis failed to take his advice to build slow sand filters. This was fortunate, but probably more by luck than reason, since with the knowledge of the sixties slow sand filters would soon have been hopelessly clogged with the turbid waters of the Mississippi. Hudson River water, clear by comparison, could be and for years was handled and greatly improved by the primitive type of slow sand filters.

The Lawrence experiments on slow sand filtration in the late eighties and early nineties put that process on its feet in this country. For a short time there was a battle royal between the supporters of slow and rapid or mechanical filtration. The latter was having the worst of the argument until it also was put on an engineering basis: first by small-scale experiments at Providence, generally overlooked now, then by the working-scale experiments at Louisville and elsewhere. Some of these were run side by side with tests of slow sand filters, in which, at Pittsburgh, the latter was called the winner and slow sand filters were built accordingly.

The fundamentals of both types of filtration were soundly established by 1900. Soon after, in the design of rapid filters radical changes, including the use of rectangular concrete instead of wood or steel tanks to contain the filter sand and gravel, smaller space requirements, greater ease of cleaning and proved adaptability for all kinds of water, made the process forge ahead until it has almost displaced the slow sand filter. Refinements and extensions of coagulation and sedimentation have played no little part in the displacement.

Chlorination, although applicable to and used with both types of filters, finally ended the battle. It overcame the slight bacterial differential in favor of slow sand filtration and made possible a reduction in coagulant used and thus in cost of rapid filtration. But chlorination has done far more service than merely to end the battle between the rival types of filtration. It has become almost universal where surface waters are used, whether filtered or not. It is now gaining the strongholds of the Far West, where water is taken from vast unsettled reaches, and is slowly but certainly making its way even in ultra-conservative New England.

Water purification in America, unused through the larger part of the nineteenth century, then adopted, haltingly at first, for extreme cases of turbidity, color or sewage pollution, is so rapidly increasing in use, and in demand where not yet available, that before many years no self-respecting American city using a surface water supply will be without its purification plant. The degree of treatment will depend on local physical conditions and civic sense and pride. Treatment for well waters, free from bacterial pollution but containing excessive hardness, or iron, or manganese, or being highly corrosive, will come less rapidly but no less surely. Soon the people of all our cities will demand not only safe water but also water that is clear, colorless, sparkling, free from odor and taste. Then will have come the age of water refining, so happily and prophetically described by the late Prof. William T. Sedgwick at a time when but few American water supplies were even safe to drink.

Advanced Roadbuilding on Georgia's Coastal Road

Weight Proportioning, Machine Subgrading, Machine Finishing and Slump, Beam and Core Testing Supplement Industrial Railways and Maximum-Size Standard Pavers

By H. J. Friedman
Division Engineer, State Highway Board of Georgia, Savannah, Ga.

Advanced-Quality concrete road construction practice as it has developed in the United States is exemplified in the paving of the coastal highway in Georgia, one of the greater highway projects of recent years. The work described is notable not because it is exceptional but because it is typical of the closely controlled, highly mechanized American practice of concrete road construction. With two outfits, 33 miles of 18-ft. concrete slab was put down in virtually six months. This broke no speed records, but showed a consistently fast pace.
—Editor.

THE coastal highway through Georgia is 136 miles long and extends through six counties. This article describes the 33-mile concrete paving operation from Midway, 30 miles south of Savannah, to Darien, Ga. The project as a whole was outlined in *Engineering News-Record*, April 28, 1927, p. 690.

Grading between Darien and Savannah was begun in July, 1924, and was completed in June, 1926. After being under traffic and maintenance for eight months the contract for concrete paving from Darien to Midway was let to the William P. McDonald Construction Company. Paving was started Feb. 16, 1927, and was completed Aug. 29, 1927, a total of 180 calendar days, Sundays excluded. In bidding, the contractor was required to indicate in his proposal the number of calendar days, excluding Sundays, he would require to complete the contract, and this time at $150 per day was included as an item of cost in totaling the bid. The McDonald Construction Company bid 200 days, which at $150 per day added $30,000 to the amount of its proposal. As it completed the work in 180 days, it was credited with twenty days at $150, or $3,000, on the final estimate. The calendar day rather than the usual working day was used in computing time to avoid difficulties in deciding what constituted a working day.

Pavement Section—As it was realized that at bridge ends and also on several marsh fills there might be an excessive cracking with plain concrete, the contract included 17,749 sq.yd. of reinforced-concrete pavement to be used where required, the remaining 328,496 sq.yd. being the standard Georgia section for plain concrete except that an 8-6-8-in. section rather than 9-6-9-in. section was used. Fig. 1 shows both types of pavement.

FIG. 2—BATCH-BOX TRAIN DELIVERY TO PAVER

Equipment—The work was handled by two outfits, each equipped as follows: one paver, one scarifier templet pulled by the mixer, one finishing machine, one subgrader traveling on the steel forms, one 10-ton three-wheel roller, one 2-ton tractor and one 8-ft. road machine for fine grading. To supply the mixers ten 8-ton gasoline locomotives, 150 two-batch cars and 20 miles of narrow-gage sectional track were used (Fig. 2). At the material yard three ¾-yd. clamshell gasoline shovels were stationed. The sand and gravel were measured by weight, two aggremeters being used (Fig. 3).

Shipment of Aggregates and Haul Layout—The Seaboard Air Line Railway was the only railroad within

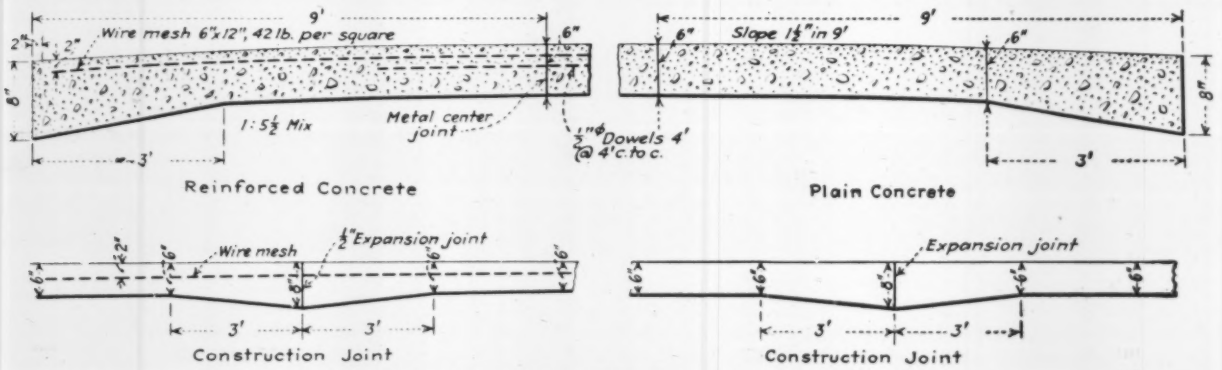


FIG. 1—STANDARD CONCRETE ROAD SECTIONS IN GEORGIA

FIG. 3—UNLOADING AND BATCH-PROPORTIONING PLANT

haul distance of the job (Fig. 4), and the contractor carefully selected his sources of supply of aggregates so that they would be shipped with the fewest transfers. Gravel was shipped from Montgomery, Ala., slag from Birmingham, Ala., and sand from Mack, Ga. This brought all aggregates into Savannah over the Montgomery division of the Seaboard Air Line Railway; from there they were brought out to Riceboro and Warsaw, the two plant set-ups, by local freight. The railroad had agreed to run a swing train from Savannah to the job with aggregate shipments if it were necessary. There were, however, practically no delays awaiting materials. The first material yard set-up was made at Riceboro, at which point the Seaboard Air Line Railway crosses the coastal highway.

One mixer was started at Riceboro, working toward Darien. The second mixer was started at Midway, the north end of the contract, and worked into Riceboro. When the second mixer had reached Riceboro and the first was approximately 8 miles south, the loading plant and the second mixer were shipped by train to the Warsaw set-up. The move involved about one week's delay. The Warsaw set-up was about 5 miles from the station at Warsaw. From Warsaw to the plant the Twin Tree Lumber Company handled all cars over its private spur on a tonnage basis, using railroad weights. The second mixer then started at a point 9 miles north of Darien and worked into Darien. The first mixer, which started at Riceboro, continued south to the Warsaw plant and on to the point 9 miles from Darien where the second mixer had begun.

Construction Details and Methods of Control—The mix was 1 part cement to 5½ parts of aggregate, with a maximum of 2¼ parts of sand. A maximum of 5½ gal. of water, including the water in the sand, was used. The proportions of sand and gravel were established by trial. It was found by working strictly on the fineness-modulus method of proportioning that too harsh a mix resulted. The average mix for the entire job was 1:2.12:3.38.

A field laboratory was set up at the material yard. The mix was corrected daily for changes in moisture content and a daily check on the weight and grading of the sand and gravel was made. A sample field-laboratory data sheet is shown by the accompanying tabulation. In addition, sand and gravel samples were submitted to the state highway laboratory at East Point on an average of twice a week. Cement was tested at the East Point laboratory from samples shipped from the mill. At the material yard the weight per sack of the cement was checked by weighing twenty sacks from each car. This was done by a plant inspector, who also kept a check on the sand and gravel weights on the aggremeters, a tally of the sacks of cement loaded on each batch and a car record of all materials. The cement was found to run uniformly above the standard 95 lb. weight. The average on three different brands was respectively 97.5 lb., 98.3 lb. and 97 lb.

Grades were based on profile levels and cross-sections and were laid to balance quantities as nearly as possible so that the earth removed from the subgrade would take care of shoulder construction. Steel forms were placed after the base had been worked approximately to grade by a 2-ton tractor and 8-ft. road machine. A subgrader (Fig. 5) was then pulled over the forms by a 10-ton roller and all irregularities were worked out. The subgrade was then rolled, watered and checked by hand with a templet. All forms were straight-edged twice. As a final subgrade check a scarifier templet pulled by the mixer was used. An inspector was stationed with

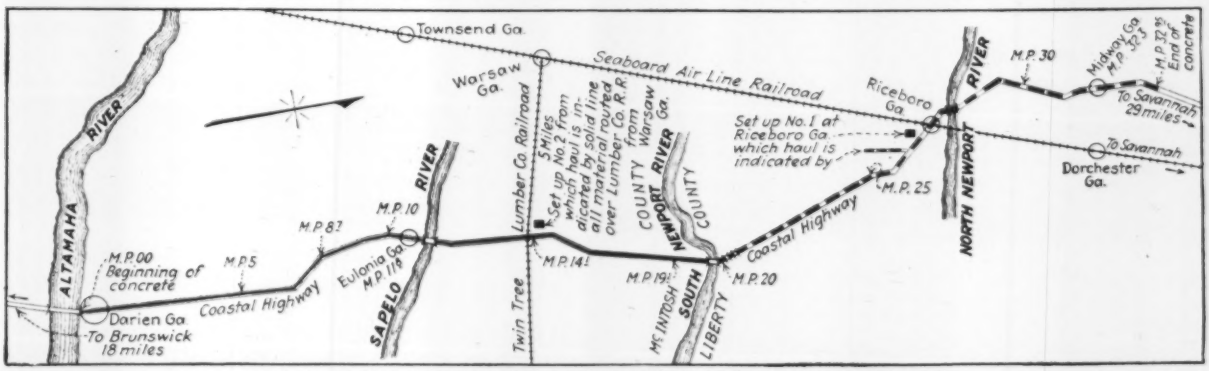


FIG. 4—PLANT SET-UP AND HAUL LAYOUT FOR 33-MILE OPERATION

FIG. 5—SUBGRADER GUIDED BY FORMS MACHINING SUBGRADE

each mixer. It was his duty to see that the subgrade was kept moist ahead of placing the concrete and that the automatic water-measuring device and the mix timing control were properly set. A mixing time of 70 seconds was used.

On each day's run, averaging 800 ft., the inspector made two slump tests, two cylinders for compressive strength and two 6x6x30-in. beams for transverse strength (Fig. 6). A slump of ¾ in. to 1½ in. was used. The average water content per sack of cement was 4.6 gal., including the water in the sand.

Following the finishing machine the surface was checked with an aluminum straight-edge and any irregularities were taken out with a wood float. The usual ¼ in. variation in 10 ft. was allowed. A final hand belting was then given. Joints in the plain concrete were placed only at the end of the day's work or where operations had been delayed more than 30 minutes.

The concrete was immediately protected with canvas frames (Fig. 7) moved on rollers. As soon as it had set sufficiently the frames were moved forward and the concrete was covered with burlap strips, which were kept thoroughly saturated. The following morning the burlap and the side forms were removed. The surface was again straight-edged and any irregularities were worked out. The concrete was then covered with 3 in. of earth and kept wet for ten days. At the end of eighteen days the earth was removed and at the end of 21 days the concrete was opened to traffic.

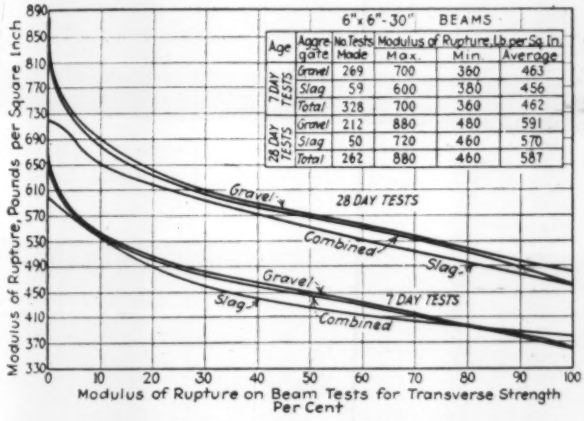
Tests of Concrete—Two breaks were made of each beam for transverse strength, one at seven days and the other at 28 days. The curves, Fig. 8, indicate the results secured. By comparison with the curves, Fig. 9, for cylinder breaks it will be noted that there is less variation proportionately in the transverse strength results than in the compressive strength results. The average results indicate that the seven-day transverse strength is 13 per cent of the 28-day compressive strength and the 28-day transverse strength is 16 per cent of the 28-day compressive strength. From these proportions the 28-day compressive strength could be predicted with reasonable accuracy at seven days.

FIG. 7—CANVAS SUNSHADES ON ROLLING FRAMES

At a number of points where it was difficult to detour local travel the seven-day modulus of rupture was used as a check on the strength of the concrete for opening the paving at the end of the ten-day curing period. Such sections were short in length and were subjected to very light local travel and no ill effects were observed on the paving.

The final strength and the thickness of the concrete was checked by cores taken (Fig. 6) at 2,500-ft. inter-

FIG. 6—FIELD TESTS AND TESTING APPARATUS



Age	Aggregate	No. Tests Made	Modulus of Rupture, Lb. per Sq. In. Max.	Min.	Average
7 DAY TESTS	Gravel	269	700	360	463
	Slag	59	600	380	456
	Total	328	700	360	462
28 DAY TESTS	Gravel	212	880	480	591
	Slag	50	720	460	570
	Total	262	880	460	587

FIG. 8—CHART OF BEAM TEST RESULTS

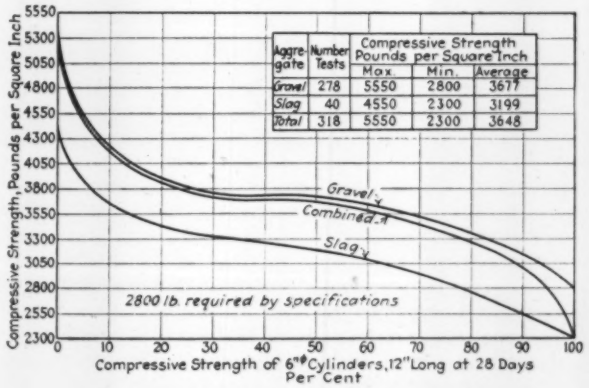
vals. Of a total of 71 cores, eleven were broken in such a manner that their lengths could not be accurately determined. Of the 71 cores, 25 were broken in removal. Of the remaining 46, partial fracture was indicated in nine cores, as shown by wide discrepancies in compressive strength. The results on these nine cores were discarded as unreliable. The remaining cores showed an average compressive strength of 4,153 lb. per sq.in.

It will be noted that the strength of slag-aggregate concrete fell consistently below that of gravel-aggregate concrete. Considerably more difficulty was experienced in finishing the slag concrete.

Water was obtained for the most part from artesian wells. On a few sections it was necessary to use water from tidal streams which were slightly brackish. With gravel aggregate the compressive strength of 28-day cylinders using artesian water was 3,606 lb. per sq.in., and 3,538 lb. per sq.in., using the brackish water.

Crack Survey and Blow-Ups—At the conclusion of the work a careful crack survey was made. There was a total of 438 construction joints and 1,333 contraction cracks. The contraction cracks averaged 17.3 ft. long. The spacing of all transverse cracks, including construction joints, averaged 98 ft. for the entire job. There was a total of 169 longitudinal or subgrade cracks averaging 10.2 ft. long. Cracking occurred in the plain concrete section only.

On that section between mile posts 20 and 32.95 twelve blow-ups occurred. These blow-ups showed up only in the plain concrete sections and at the construction joints placed at the end of the day's work. The blow-ups



Aggregate	Number Tests	Compressive Strength Pounds per Square Inch Max.	Min.	Average
Gravel	278	5550	2800	3677
Slag	40	4550	2300	3199
Total	318	5550	2300	3648

FIG. 9—CHART OF CYLINDER TEST RESULTS

covered the full width of the pavement and developed in the heat of the day when expansion was greatest. They were usually characterized by the buckling of the slabs and then fracturing at a point about 5 ft. back from the joint. On the section of road where the blow-ups occurred the construction joints were given a width of $\frac{3}{4}$ in. and were poured with asphalt. From mile post 0 to mile post 20 no blow-ups occurred. On this section the construction joints were butted together without any spacing between the concrete slabs. However, on this section the concrete was poured during the summer months when expansion was greatest, so that the absence

DAILY FIELD LABORATORY DATA FOR CONCRETE PAVING MIX

Project No. 117-2
Date, Aug. 17, 1927
Inspector, W. H. M.

Aggregate Data:

	Weight Per Cu. Ft. Dry Loose, Lb.	Per Cent Moisture by Weight, of Dry Loose Weight	Specific Gravity
Cement	94	....	3.1
Sand	96	4.3	2.65
Gravel	100	1.0	2.65

Mix Data for Six-Bag Batch:

	Cement	Sand	Gravel
Mix, dry loose materials	1 part	2.092 parts	3.408 parts
Mix, dry loose for six-bag batch by volume	6 sacks	12.552 cu.ft.	20.448 cu.ft.
Mix, dry, loose for six-bag batch by weight	6 sacks	1,205 lb.	2,045 lb.
Moisture correction to be added	.....	52 lb.	21 lb.
Field mix, as weighed from aggregate meters	6 sacks	1,257 lb.	2,066 lb.

Cement Content:

Cement $\frac{94 \times 1}{3.1 \times 62.5} = 0.49$ cu.ft. absolute volume

Sand $\frac{96 \times 2.092}{2.65 \times 62.5} = 1.21$ cu.ft. absolute volume

Gravel $\frac{100 \times 3.408}{2.65 \times 62.5} = 2.06$ cu.ft. absolute volume

Water $\frac{5.5}{7.5} = \frac{0.73 \text{ cu.ft. absolute volume}}{4.49 \text{ cu.ft.}}$

4.49 cu.ft. absolute volume of one sack cement: 2.092 cu.ft. sand: 3.408 cu.ft. gravel and 5.5 gal. water.

Cement factor per cu.yd. of concrete $= \frac{27}{4.49} = 6.01$ sacks, or 1.50 bbl.

Concrete per six-bag batch $= \frac{4.49 \times 6}{27} = 0.997$ cu.yd.

Material Yields:
0.35184 cu.yd. = volume per lin.ft. of pavement
0.35184 × 1.50 = 0.5277 bbl. cement per lin.ft. of pavement
0.997 ÷ 0.35184 = 2.83 lin.ft. of pavement per six-bag batch

$\frac{6.01 \times 2.092}{27} = 0.4656$ cu.yd. sand per cu.yd. of concrete

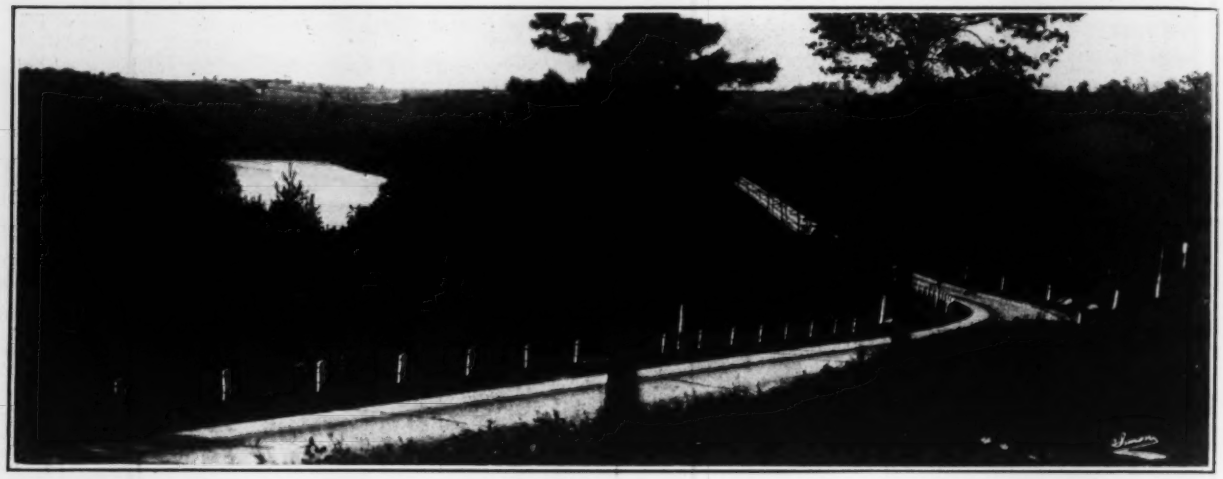
$\frac{6.01 \times 3.408}{27} = 0.758$ cu.yd. gravel per cu.yd. of concrete

Screen analysis of gravel and sieve analysis of sand follow.

of blow-ups could not be conclusively attributed to the type of field joint alone.

Amounts of Materials—The total materials used on the job were 95,225 bbl. of cement, of which 21,342 bbl. was imported from Belgium; 29,907 cu.yd. of sand; 37,764 cu.yd. of gravel, and 10,039 cu.yd. of slag.

Organization—The William P. McDonald Construction Company, Lakeland, Fla., was the contractor, with W. J. McLain superintendent in charge. The coastal highway district's interests were handled by Harvey Granger, chairman, and E. L. Stephens, field superintendent. The state highway department supervised the work. W. R. Neel is state highway engineer and S. B. Slack is bridge engineer. The Savannah division had direct supervision, with A.L. DeTreville in charge in the field.



Impounding Reservoir of the York Water Company, Pennsylvania, on the Susquehanna Trail. Extensive Reforesting Operations Have Been Conducted on the Tributary Drainage Area.

Association Surveys of the Vast Water-Works Field

Abstracts of Papers, Reports and Discussions Before the Forty-Eighth Annual Convention of the American Water Works Association

AN EMBARRASSMENT OF RICHES was presented to the 48th annual convention of the American Water Works Association, held at San Francisco, Calif., June 11 to 15. The technical proceedings alone embraced 70 papers and committee reports. Most of the topics uppermost in the minds of water-works superintendents, engineers, chemists, bacteriologists and their associates received at least brief consideration. Some were treated in much detail. New appliances, materials and methods were brought forward; new theories and opinions aired.

To give a comprehensive picture of the extensive technical proceedings at the convention the papers and reports have been regrouped and abstracted, without regard to order of presentation. Condensation has been imperative. Practically every topic presented has been given more than categorical mention, the chief omissions being a half dozen papers describing individual works or projects germane to a meeting on the Pacific Coast, such as the new water supplies for San Francisco, Oakland and other transbay cities, and the proposed Los Angeles-Colorado River Aqueduct already described in *Engineering News-Record*, and a few other papers received too late for abstract. Lack of space in this issue makes it necessary to postpone publication of groups of papers on Sources of Supply, Protection and Purification of Water Supplies and Management and Finance.

Association business transacted at the convention is summarized in the Current News Section of this issue, and notes on the exhibits of water-works materials and appliances are presented in the Manufacturers' Section.

—EDITOR.

Pumps, Boiler Feed, Tanks and Reservoirs, Open and Closed

PROCEEDINGS of two conferences held by the boiler feed committee, in which several phases of boiler feed water were taken up, are here combined with papers on pump selection, tanks and reservoirs, the latter including experiences with open and closed reservoirs at Washington, D. C., in relation to quality of water, and unusual tank and reservoir problems in a California water district having nearly 48 such structures serving 26 zones.

Selection of Pumps To Fit Service Conditions

BY F. G. CUNNINGHAM
Of Fuller & McClintock,
New York City

Selection of pumping equipment is too often based upon a comparison of prices and full-load test duties without sufficient consideration of collateral aspects and the entire station program for years to come. A proper study must include estimates of all uses and losses of energy in the station, operation at fractional loads, boiler units, building space, operating labor, maintenance and many other things.

As to pump unit sizes: Analysis of a year's hourly pumping rates at Toledo, Ohio, showed that with an average pumpage of 30 m.g.d. the rate was less than this 61 per cent of the time, while for 33 per cent of the time it was between 100 and 150 per cent of the average. One 30-m.g.d. triple-expansion unit pumped more than 80 per cent of the water used. It was concluded that, by adding a 30-m.g.d. turbine unit, consumption beyond 60-m.g.d. could be handled by far less efficient stand-by equipment without material increase of the coal bill. Therefore a 30- instead of a 50-m.g.d. pump was bought.

Other conclusions favor designing for fractional capacities and usual heads; having, as a rule, all high-service units of a uniform and moderate size, probably not exceeding the average annual demand at time of installation; taking into account that "at most water-works stations the payroll exceeds the fuel cost," so that "owners should consider carefully before installing equipment that might require an increase in the maintenance or the operating personnel." Recent practice in driving low-service pumps has included the use of electric power from generators on the main or high-service pump shafts and also the use of turbines operated with water from the high-service pumps. It is now possible to vary the speed and capacity of electrically driven pumps over as wide a range as is ordinarily necessary by varying the

speed of the alternators supplying them with power, in cases where the alternators are owned by the utility and are not used for other services that would be adversely affected by moderate speed and frequency variation.

Boiler Feed Water

Standards Committee No. 19, boiler feed water studies, held two conferences. Chairman S. T. Powell, consulting chemist, Baltimore, Md., stated that the work in which his committee is taking part is sponsored by six of the major engineering societies, centered largely in a technical committee and directed by an executive committee.

Studies along 27 lines are being made. The joint finance committee estimates that $60,000 a year for five years will be needed to carry on proposed researches, divided as follows: Priming, foaming, etc., $10,000; surface condensers, evaporators and de-aerators, $10,000; corrosion and electrolytic scale prevention, $20,000; embrittlement of boiler steel, $20,000. Funds in hand total $3,000, and there is a commitment of $20,000 a year, contingent on contributions from allied interests to make up the $60,000 a year. Bibliographies on feed water problems have been completed. Work is in progress on standard methods of water analysis for industrial work, principally for boiler feed.

Five papers were on the conference program. The necessity of water treatment to inhibit sodium carbonate embrittlement was highly stressed by Prof. F. G. Straub, department of chemistry, University of Illinois. Laboratory experiments show that sodium sulphate, sodium phosphate and tannin will stop embrittlement when used in proper amounts. Methods of application of the sulphate and phosphate treatment to boiler feed water were discussed for specific types of feed waters and operating conditions.

Condenser corrosion prevention by an electrolytic preventive system in use at the Long Beach steam plant of the Southern California Edison Company was described by Frank G. Philo, of Los Angeles, superintendent of the company's steam-generating stations. His paper also dealt with the theory and general practice of the subject. Other papers dealt with prevention of scale formation (R. E. Hall), electrolytic methods to prevent corrosion (L. O. Gunderson) and floods and railway water supply (C. R. Knowles.)

Tanks and Reservoirs of Marin Municipal Water District

By J. C. Peters
Chief Engineer, San Rafael, Calif.

The Marin Water District now operates 26 different pressure zones to serve about 12,000 service connections. To supply these 26 zones we have 38 wood tanks ranging in size from 10,000 to 200,000 gal., six 0.2- to 1.5-m.g. steel tanks and four 0.8- to 7-m.g. concrete-lined reservoirs. Two 0.2-m.g. steel tanks are now being built and plans are being drawn for a 2-m.g. steel tank to be built next summer.

Large Steel Tank—The 1.5-m.g. steel tank was built in 1927. It is 95 ft. in diameter and 29 ft. high and rests on the earth. All bottom and shell seams are riveted. The roof is welded. The bottom plates are $\frac{3}{8}$-in. thick. The lower shell course is $\frac{5}{8}$ in., other courses reducing in thickness to $\frac{1}{4}$ in. at the top course. The cost of this tank was $27,130, or 1.808c. per gallon of storage, including foundations, fittings and painting.

There were no unusual features in the design of this tank except perhaps the bottom, which was made extra heavy to insure longer life. The lower side of the bottom was painted with bitumastic enamel before lowering to the foundations. The inside of the tank was also enameled after testing. The enamel work was done under contract at a cost of 11c. per square foot.

The foundation was made on a hillside by excavating a level bench with a gas shovel, after which we backfilled with earth an area 4 ft. larger than the diameter of the tank. This earth was dampened with water and rolled to form a cone 5 in. high at the center of the foundation. Next 2 in. of No. 4 crushed rock was spread, rolled and sprayed with No. 2 road oil, about 1 gal. per square yard. The oiled surface was then dusted with rock screenings and rolled. After this surface had hardened, 2 in. of fresh-water sand was spread over the entire foundation to provide drainage for any water which might leak through the bottom of the tank and also to make a bed for the rivet heads.

Reservoirs Costly—Concrete-lined reservoirs here are expensive to build and difficult to make water tight. They have to be built on the top of a ridge or hill, which must be leveled off, then the reservoir excavated, more than doubling the excavation necessary for a reservoir built in a flat country. Excavation cannot be used for embankment, as earth placed on a side hill would slough and slide after the first heavy rains. With the exception of the upper 4 ft. of the side, which is above the ground line and supported by counterforts, the last reservoir of this nature built by us was completed in 1921, has a capacity of 1.1 m.g. and had a storage unit cost about double that of the 1.5-m.g. steel tank built in 1927.

In 1927 we placed 27,616 sq.ft. of reinforced 1-in. granite on 6-in. concrete-and-asphalt lining of an old 2.4-m.g. reservoir, first removing the twenty coats of "dry asphalt," then roughening the contract by air-spades and air-hammers; cost 18c. per square foot, of which 4.5c. was for the cleaning, done by the district, and 13.5c. for guniting by contract.

Experiences With Covered and Open Reservoirs

By Carl J. Lauter
Chief Chemist, Washington Filtration Plants

Three years bacterial, microscopic and chemical tests on an open and a closed reservoir in the city of Washington, D. C., both receiving the same supply from the slow sand filtration plant, chlorination then being intermittent, showed the following results:

Average bacteria count 4 for filtered water, 7.6 for the covered reservoir, an increase of only 90 per cent, compared with 44 for the open basin, an increase of 1,000 per cent. There was no micro-organism growth in covered reservoir, whereas it was abundant in open. Albuminoid ammonia, nitrate and nitrate tests also all showed much better conditions in the covered basin at all times.

Conclusions—Covered basins are much better suited than open basins to preserve the quality of water. Open basins should be protected from playgrounds, dirt tennis courts and open woods, and should be built in pairs, with positive circulating system, and be cleanable on quick

notice. Chlorination is often necessary at distribution reservoirs, especially after installation of new service mains. Sampling and testing of reservoirs is as important as daily routine on filter effluent.

* * * * *

Conserving the Supply by Finding Where It Goes and Stopping Waste

ONE of the most important tasks of the water-works engineer and superintendent is to find where the water goes, detect and stop leaks. Abstracts of papers on these topics follow, and some related matter is given under the topic, Superintendents' Round Table.

Leak Surveys in San Francisco

By V. E. Perry
Manager, Water Sales Department,
Spring Valley Water Company

A leak survey in San Francisco made in 1913 examined more than 43,000 services with an aquaphone and found 58 per cent of them to be leaking. The services were metered in 1918. In 1924 a similar survey was made on that part of the system believed to be most likely to have leaks, and only 9 per cent of the services were found leaking. In the first survey the average rate of making tests was fourteen services per hour per man; in the later survey, because the tests could be made at the curb meter box, the average was 45 per hour per man.

Discussion—The peak demand on unmetered services in Ottawa comes in winter, when faucets are left running to prevent freezing. In Memphis, Tenn., tests made to account for loss due to leakage showed that most meters would pass as much as 15 gal. per hour before beginning to register. This observation was checked by the report that salesmen of some automatic refrigerators tell customers that their machines draw such a small flow of water that it does not turn the water meter. A laundry was reported to have greatly reduced its water bill by filling tanks at night with a very small stream that did not register on the meter.

Unaccounted-For Water

By R. L. Howson
Of Alvord, Burdick & Howson, Chicago

A questionnaire on unaccounted-for water sent to 85 completely metered water-works distributed throughout the United States brought 56 complete replies, of which 44 showed measurement of all water entering the system. A summary of the principal data and a part of the resulting conclusions follows:

The 44 plants serve about 6,150,000 people. They pumped 801.8 m.g.d. during the past year to 1,244,712 services, a daily average of 130.5 gal. per capita, or 643 gal. per service per day. Approximately 73.5 per cent of the water pumped passed through the consumers' meters. The 26.5 per cent unaccounted-for water amounts to approximately 31 gal. per capita per day.

Cast-iron or steel pipe with other than screwed joints is best from the leakage standpoint. Lead and copper services are better materials, from the leakage standpoint, for the laying of service pipes than is wrought iron.

It is to the utility's interest to own the meters. The advantage, expressed in unaccounted-for water, of the utlity rather than the consumer owning the meter is approximately 3.8 per cent of all water pumped or 6 per cent of the water sold. The utility rather than the consumer should decide as to the size of meter. This decision is worth to the utility approximately 4.4 per cent of the water pumped or 6.25 per cent of the water sold. There is some advantage in charging for as well as metering all public water uses. There is need for an accurate means of testing *in situ* meters at small flows. The size of meters should be as small as practicable for the service. Larger pipe and smaller meters should be the aim. A graduated service charge based on the area of the meter opening will assist in the proper selection of meter sizes.

Discussion—There were many expressions of opinion to the effect that consumers should not be allowed to select meter sizes, and care also should be taken in other ways to avoid installation of oversize meters, because of the resultant increase of unregistered flow. During construction contractors often call for meters of larger size than the premises later require. Once installed, these oversize meters often remain. To avoid this, some water companies serve contractors who want large size meters by means of portable meter boxes that can be connected to fire hydrants.

Other Papers

Pitometer Surveys, Cyrus R. Bird, district manager, Pitometer Company, Detroit—Pitometer surveys fall in three general classes: Water-waste detection; trunk main studies; general redesign of distribution system. Water-waste surveys may reduce pumping costs, as at Buffalo, N. Y., where 12,000 tons of coal a year was saved; may increase revenue, postpone plant enlargements and increase pressure for fire protection and other purposes.

Pitot Tubes in Water-Works Practice, George D. Conlee, Republic Flow Meters Company, Chicago, Ill.—Included in this paper was a description of a recording and integrating installation, "that can be used very satisfactorily for test purposes" and has been "used quite extensively in steel mills" and other large industrial plants for measuring distribution water. In response to questions, Mr. Conlee said good practice calls for straight pipe for a length of 50 diameters ahead of the point of Pitot tube measurement. His experience showed Pitot tube results to be either right or low; high readings do not occur. The engineer's skill is essential to the successful use of this device and an interpretation of results.

* * * * *

Pipe and Other Elements of the Distribution System

SCATTERED through the program were a number of papers on various elements of the distribution system, including copper service pipes, now rapidly growing in favor. Besides the abstracts immediately following many data on valves, hydrants, meters, etc., are summarized under the topic, Superintendents' Round Table.

Cast-Iron Pipe And a New Pipe Bank

By W. W. Brush
Chief Engineer, Department of Water Supply,
New York City

Failure of Pipe Under Earth Load—Of two short papers by the new president, W. W. Brush, one dealt with the failure of a 48-in. cast-iron pipe under earth pressure up to 28 ft. (described by Joseph Goodman, *Engineering News-Record*, Aug. 25, 1927, p. 315). Lessons drawn are:

The cracking of these pipes is an unusual demonstration of the necessity of designing pipe lines to safely

carry when empty the full earth load due to deep cover and that no dependence should be placed either on the supporting power of the earth above the pipe. Fortunately there are not many cases of pipe laid with earth cover of more than 15 ft., but if such cover be used, the pipe wall thickness should be computed and even for lighter cover if very thin pipe is to be used.

New Band for Cast-Iron Pipe—Mr. Brush's other paper described a new band-and-rod design to hold cast-iron pipe from pulling apart where bends, offsets, tees, reducers or caps are used and there are no lugs on the bell or spigot. In essence, the pull of the rods on the band is taken up by anchorage of the band on the hub.

Discussion—Near the seacoast, due to salt content in moisture in the air, it has been found advisable to encase bands in concrete to avoid corrosion. No electrolysis trouble had been experienced in joints made with an amalgam of lead, tin and zinc, and no bands were used on such joints.

Copper Service Pipes

By Robert B. Morse
Chief Engineer,
Washington Suburban Sanitary District,
Hyattsville, Md.

Somewhat more than a year ago copper tubing was adopted for all ¾- and 1-in. services in the Washington Suburban Sanitary District. Estimates showed that this material would cost at least no more than the 1¼-in. cast-iron services previously in use, taking into account the elimination of some of the fittings necessary for the cast-iron but not required for the copper pipe. By the use of soft copper tubing, line deflections are easily possible and special fittings at the main and meter are eliminated.

Our present practice is to bend the end of the copper tubing into the form of a gooseneck and to connect this end with the corporation cock by a copper-to-brass coupling, then to join tube lengths together with copper-to-copper fittings, as may be necessary to reach meter housings. At this point the copper tubing is bent to a 90-deg. arc with a radius of about 6 in. and is extended vertically in the housing up to the inlet end of the meter yoke, to which connection is made by means of a copper-to-iron coupling. The copper riser is of sufficient rigidity to support the yoke and meter. Except as may be necessary to use up short lengths of piping, not many copper-to-copper fittings have to be used.

To bend the tubing use is made of a grooved wheel having a diameter of 6 in. The tubing is held under a fixed peg and the part at which the bend is to be made is placed in the groove. By the application of pressure and the gradual slipping of the tubing backward and forward the desired degree of curvature is obtained. It is possible also to bend the tubing by inserting it in a piece of iron pipe and gradually applying pressure on the latter. No perceptible distortion of section results from the bending process.

Water services in the district are laid in the same trench with sewers. The cast-iron and the earlier wrought-steel services were laid on a bench, at one side of the trench. Copper services are laid on the backfill, at the desired height. Beneath paving, a 2-in. earth auger makes a hole through which the copper pipe is passed.

For ¾-in. and 1-in. sizes, copper tubing costs less than 1¼-in. cast-iron and only slightly more than "genuine wrought-iron pipe." Lead pipe costs from two to nearly three times as much as copper, depending on sizes, is heavier to transport and install, and requires more skill to lay. Favorable consideration is being given to substituting 1¼-in. and 1½-in. copper pipe for 1¼-in. and 2-in. cast-iron pipe.

Other Papers on Pipe

Coefficients of Flow in Concrete Pipes, Fred C. Scobey, Irrigation Engineer, U. S. Department of Agriculture, Berkeley, Calif.—One thousand miles of concrete pipe is being laid each year, and the interior finish has been steadily improving, the present standards producing a pipe in which n is equal to about 0.013.

Of three more papers in this group, one by E. A. Rowe, engineering offices of J. B. Lippincott, Los Angeles, described at length the construction of a large gunited steel and centrifugally cast concrete pipe line for Laguna Beach, Calif. Bonds to the amount of $600,000 averaging about $400 per capita of registered voters, were authorized for the water system of which the line is a part, without a dissenting vote, 95 per cent of the registered voters going to the polls. Professors L. T. Jones and Walter S. Weeks, Berkeley, Calif., gave a detailed account of studies of the control of stresses in pipe-line construction. W. S. Hulbert, office engineer, Los Angeles water-works, described local practice in the use of cast-iron service pipes, enumerating the following advantages of this material: No injurious effect on consumers from water passing through, and no taste or odor imparted to the water; adequate capacity, strength, durability, resistance to electrolysis, easy installation and moderate cost.

Dead Ends

By S. B. Morris
Chief Engineer, Water Department,
Pasadena, Calif.

Unanimous disapproval of dead ends—which term I do not find in Webster, Trautwine, Flinn, Weston and Bogert, or our own A.W.W.A. "Water Works Practice"—is shown by an inquiry sent to eight of my water-works friends. All provide a fire hydrant or blowoff where an active service connection at the extreme end of the main is lacking. [After a detailed review the author concludes, in part:]

Dead ends should be restricted, for they tend to decrease pressures, lessen fire flows, increase shutdowns, increase water hammer, increase complaints of tastes and odors, and in some cases increase corrosion, particularly from electrolysis. The growing use of duplicate mains on each side of a street should make the number of dead ends between pressure districts less necessary.

Fire plugs on dead ends are desirable for flushing, but not so satisfactory for fire protection.

For average water conditions sealed services should present no greater problem than active services. Where severe conditions are known to exist, sealed services can be installed with the corporation cock at the main closed, and a valve box installed over such cock so that the service can be turned on when required. In this way water is not turned into the services until it is to become an active service. This is the present practice in some cities.

Effect Upon Corrosion—There appears to be a general opinion that dead ends or sealed services are much more rapidly affected by interior corrosion than pipes through

which water is constantly moving. A theoretical discussion of the active elements of corrosion and observations of many sealed services in comparison with active services do not appear to sustain this opinion. Hydrogen-ion concentrations represented by values of pH greater than 10 are only slowly corrosive, between pH 4.3 to 10 moderately, and less than a pH of 4.3 rapidly corrosive. Here again oxygen must be present to break the polarizing film of neutral hydrogen atoms on the metal to complete the corrosive action under the electrochemical theory of corrosion.

Discussion — Contrasting with Mr. Morris' experience, William W. Brush reported observations that would justify rating a pH as low as between 6 and 7 as actively corrosive. Endeavor was made to increase the pH, and it was brought up to 8.4. This decreased but did not entirely eliminate corrosion.

Hydrants and Valves

By J. I. Prugh
Superintendent, Division of Water,
Sacramento, Calif.

Absence of grades at Sacramento makes it unnecessary to have even the large mains buried more than 2½ to 3 ft. Because an unusually large number of valves are used to avoid service interruptions when a break occurs, it has not been desirable to use a manhole for each valve. Instead, a short length of 8-in. pipe is set vertically around the valve stem, the upper end being covered by a heavy plate at the level of the pavement surface. The base of the 8-in. pipe rests on short lengths of old rails placed across the pipe trench, thus preventing heavy traffic shocks from being transmitted to valve or pipe. The valves can be repacked through this 8-in. pipe, since it is short. In the last five years only fifteen valves have required repair and most of these had been installed before the above-described plan had been adopted.

Discussion—In contrast to Sacramento experience, W. E. MacDonald pointed out that in Ottawa mains require a 7-ft. earth covering to avoid freezing. He also said that the adoption of stainless steel spindles in large valves has added only 8 to 10 per cent to the cost and has been found greatly to prolong the life of large valves which are frequently operated. In Ottawa, due to possibility of as much as 2 ft. of ice covering over pavements, it is often difficult to find the exact location of valves. Hence 2½x3½-in. bronze plates are set on buildings or telegraph poles at a standard height of 7 ft. above the curb, each plate giving the exact distance from plate to valve. All valves on mains from 12 in. up are operated by trucks at a great saving in time of closure. Good practice calls for making the last few turns of closure by hand instead of by machine to avoid the danger of water hammer.

* * * * *

Superintendents' Round Table

Conducted by W. E. MacDonald
City Water-Works Engineer, Ottawa, Canada

THE closing afternoon session was devoted to a superintendents' round table discussion, a continuation in a new form of the old Question Box, which for decades appeared so regularly on the convention programs. To guard against the rambling discussions and frequent vacuums of some of the old Question Box sessions, a long series of questionnaires was mailed out with request that replies be sent to W. E. MacDonald, chairman plant management and operation division, for advance tabulation. Substantially all the data thus accumulated follow, in compact form.

Cost and Other Records—A request for "what data you have to compare first and maintenance costs and the life of various materials used" showed that only 23 of 64 cities keep such costs. Another query brought out the fact that records for service lines, meters and meter tests are kept by 51 of 64 works. The majority use a card index showing location, date of installation, cost of installation, maintenance and repairs. For plotting new water mains, valves and hydrants, "the large majority of the cities" use general maps to a scale of from 800 to 100 ft. per inch; and sectional maps with scales of from 100 to 20 ft. per inch. A further query as to scales used for detail maps of the distribution system showed a range from 400 to 10 ft. per inch, with 18 of 52 using 100 ft. per inch, 11 of 52 using 50 ft. per inch and not more than 4 using any one of the other scales.

Financing Main Extensions—Of 54 cities answering: Bonds, 20; local improvements, 16; earnings, 12; consumers, 4; guarantee of 10 per cent of cost, 5; "company," 3; assessing $1 per foot on each side of street (relative cost of 6-in. main), 1.

Centrifugally Cast Iron Pipe—Preference for this kind of pipe rather than ordinary sand cast was expressed by 23 cities against 37 saying no and 2 not answering.

Size of Fire-Service Lines—Of 55 cities expressing an opinion on whether a "fire line as large as the main on the street" is "good practice," 40 were against and 15 were favorable.

Copper Service Pipes—Use of copper services was reported by 26 cities, and no experience by 38. All reporting use said it was "very satisfactory" in sizes of ½ to 2 in.

Grounding Electric Currents on Water Pipes—No trouble, 46; do not favor, 16; no reply, 2. A query as to other remedies brought no suggestions.

Paving and Leaks—On whether street paving increases leaks in mains and services, 39 cities said no; 12, yes; 13 made no report.

Valves and Hydrants—Regular inspection of gate valves is made by 47 and not made by 17 cities, with 24 which consider yearly and 12 half-yearly inspections desirable, the remainder of those having regular inspection not stating how often. As to location records, 70 per cent of those replying (actual number not given) record location, date installed, number, size, turn; 15 per cent use maps or book records only; 15 per cent keep no records. No experience with horizontal gate valves having beveled gears compared with the vertical spur-gear type was reported by 30 cities; 24 having a preference are equally divided between the two types; 10 are satisfied to use either kind. As to fire hydrants, to locate those frozen, 30 have an organized system and 34 do not.

Meter and Meter Rates—On attempts to prevent damage to meters by hot water backing up, 35 reported no attempts; 24, attempts; 5, no damage. As to who bears the cost when damages occur, 45 reported that the consumer pays and 10 that the utility pays. Monthly readings is the practice in 37 and quarterly billing in 32 of 64 cities, with the remark that "monthly reading gives better meter control" and "quarterly reading better burden distribution." Opinion on whether it is best to leave the meter in the meter box or remove it when water is turned off was divided 38 to 26 respectively. Stated periodic tests or removals of meters are made by 33 of 54 cities.

Opinion on whether straight reading dials are more expensive to maintain stands 36, yes, to 16 finding no difference. As to position for meter installations, 32 preferred the curb, 27 the basement and 5 put large meters at the curb and small ones in the basement.

Uniforms are worn by meter readers in only 5 of 64 cities and not worn in 47, but badges are displayed in 12 cities. Corresponding preferences are 27, 23 and 14, respectively. Opinion as to the desirability of metering all automatic sprinklers used by mercantile houses, with dry pipe system, where all water sold is sold by meters, stood 45 for to 19 against. Flush meter valves in toilet fixtures are reported satisfactory by 28 plants and not favored by 16, while 20 report no experience. The standard A.W.W.A. meter rate structure, with graduated service charges and stepped consumption charge, is not used by 43 of 64 cities, used and favored by 19, used but in disfavor with the public in 2 cities. As to how complaints of high water bills are handled (60 replies) 33 cities report by testing meters and making allowance for over-registration; 21, by showing the consumer where the water goes and adjusting if necessary; 6, miscellaneous.

Charges for Turning on Water—No charge for turning water onto services is made in 45 and a charge is made in 19 cities. Where there has been a shut-off for non-payment of water rates, 22 cities charge $1, six 50c., three $2. For "merely turning on water at any time," 19 cities charge $1.

Emergency Maintenance Equipment—All 64 cities replied to the query, "What new maintenance equipment devices do you use to meet emergencies?" The various devices reported are: Portable gas pumps and gasoline thawer; portable derrick on truck; portable air compressor; pipe pusher; electric leak locators; pipe locators; magnetic box finders; gate-operating device on trucks; 3-in. centrifugal pump; geophone; aquaphone; welding equipment; gasoline shovel; dipping needles; split sleeves; caterpillar cranes and trench diggers; floodlights.

Algæ and Phenol Troubles—No algæ troubles were reported by 35 cities, while 29 have had them. Of the 29 reporting trouble, 27 give control methods used: 23 use copper sulphate; 2 prechlorinate; 1 cleans the basin; 1 produces artificial turbidity before filtration. Only 7 of 62 cities reported phenol tastes, to overcome which 2 use filtration and aeration, while 1 each uses ammonia, flushes mains, drains phenols wastes to river and does not give method.

* * * * *

Reports of Technical Committees

THE Standardization Council made no report, but there were progress reports from a number of its sub-committees, besides reports from one or two other committees, all summarized below. The boiler feed committee, which is working with committees of a number of other technical societies, held two conferences, the proceedings of which are summarized under the topic, Pumps and Boiler Feed Water.

Standard Forms of Contract, J. Waldo Smith, chairman, New York City—There is evidence of increase in use of the standard form of construction contract. It is not possible, as in the case of building contracts, to have a form which is the actual contract document, because the engineering form of construction contract has to cover so many differing conditions and types of construction, such as sewers, tunnels, pipes, buildings, machinery, etc., and the best that can be done at present with the engineering contract is to establish a guide on which to base the form of contract. There is a tendency to increase the use of the arbitration clause, but it is probable that growth along this line will be slow, because the legal departments of municipalities will be reluctant to allow such a clause to be written into the construction contracts.

Revision of Manual, Paul Hansen, Chicago, chairman—As to Chapters 7 to 12 of the A.W.W.A.'s "Water Works Practice," the committee feels the large amount of space devoted to the application of iodine to public water supplies to prevent goiter should be reduced; also that the subject matter in Chapters 7 to 12 should be redistributed and that sterilization, aeration, plain sedimentation, the two types of filtration, removal of iron and manganese, sterilization and prophylactic methods might be treated in accordance with the following outline: Historical; object, limitations and advantages of process; equipment required, with bold diagrammatic outline; physics, chemistry, biology and physics of process; variations to meet changing conditions; operation, including difficulties; special details of design; analytical control, efficiency; costs. The committee was discharged.

Standard Methods of Water Analysis, Jack Hinman, Jr., chairman, Iowa City, Iowa—From this very active committee of seventeen members came a lengthy report, including various sub-reports from members serving as referees, and closing with twenty recommendations for future work by the committee. Harry Jordan, Indianapolis, submitted recommendations for the use of brilliant green lactose peptone bile in parallel with lactose broth in determinations for the Bacterium coli group. Work on the detection of phenols, done by R. C. Bardwell and J. R. Baylis, was outlined. A new method for determining the water content of nannoplankton, "the smallest of the organisms superior to bacteria," was reported (W. F. Langelier, referee). These organisms are so small that they elude both the Sedgwick-Rafter and the Hansen net methods of recovering them, but it is hoped that the new net, with 350 meshes per square inch, will secure more of the organisms, although thus far the results have not been wholly satisfactory. (See paper by Langelier, *Journal*, A.W.W.A., April, 1928.)

Pipe Flanges and Fittings, F. A. Barbour, Boston, chairman—The A.E.S.C. sectional committee on pipe flanges and fittings has compiled eight of its eighteen projects and they have been approved by the main committee as Tentative American Standards and published in standard form (Am. Soc. M.E., Engineering Societies Building, New York City). Of these, two cover malleable-iron and cast-iron screwed fittings and six cover cast-steel flanges, 250 to 1,350 lb. w.s.p. [Since the date of the report standards for cast-iron flanges, 125 and 250 lb. w.s.p. have also been published.] Work on a number of other projects is in various stages and on two or three has not yet been started.

Progress Reports—General progress was reported for the A.E.S.C. sectional committee on manhole frames and covers (Frank A. Marston, Boston, chairman), while for the committee on industrial wastes in relation to water supply (Almon L. Fales, Boston, chairman), only a general statement was made in view of the section on control of tastes and odors by chlorination in the paper on Progress of Chlorination, by L. H. Enslow, to be noted in a later issue.

Strength Specification Concrete for Street Paving

Unusual Water-Cement Ratio Requirements Caused Little Additional Work and No Additional Cost

By F. A. Hess
Assistant Engineer, Kelker, De Leuw & Company, Chicago, Ill.

AT MUNDELEIN, Ill., a new and rapidly growing community near Chicago, the conditions were such as to permit the use of strength specifications for concrete paving during the 1927 season; a minimum compressive strength was specified, instead of the proportions of the concrete mixture.

The first contract was for 52,000 sq.yd. of reinforced-concrete paving on 60-, 40- and 27-ft. roadways with combined curb and gutter. The reinforcement was a steel bar not weighing 70 lb. per 100 sq.ft. Longitudinal concealed metal joints were placed at the center with additional joints at 10-ft. intervals on each side in the two wider pavements; and transverse expansion joints of the prepared asphalt type were spaced 33 ft. apart. The thickness was 7 in. for the 27-ft. paving and 8 in. for the wider streets.

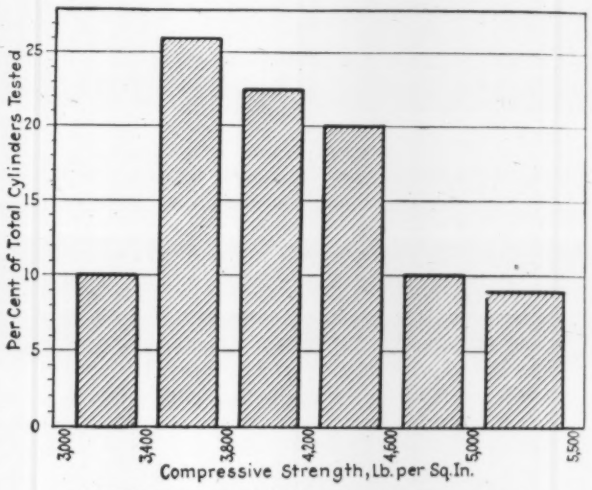
The specifications required the concrete to be proportioned to give the necessary workabilty and to have a minimum compressive strength of 3,000 lb. at 28 days. They required the moisture in the aggregate to be measured by a method giving results within 1 lb. for each 100 lb. of aggregate. The proportions of aggregate to cement was to be such as to produce concrete that could be puddled readily into the corners and angles of the form and around the reinforcement without excessive spading and without segregating or undue accumulation of water or laitance on the surface. No concrete was to be placed which showed a slump greater than 2 in.

As a check on the quality of the concrete it was specified that if any was found deficient in strength on the 28-day test a deduction of 10 per cent of the bid price per square yard should be made for each reduction of 100 lb. or fraction thereof below the required 3,000-lb. compressive strength. If any concrete should show less than 2,000 lb. strength the contractor might be required to replace it.

The ratio of coarse to fine aggregate was specified to be not less than 1 nor more than 2. The methods of measuring must permit the proportion of water to cement to be closely controlled and easily checked by the engineer. Aggregates were to be delivered and handled in such a manner that variations in moisture would not interfere with the steady production of concrete of reasonable uniformity. Each batch was to be mixed for at least one minute and the mixer was to have a peripheral speed of about 200 ft. per minute. It was required that the pavement be tamped and finished with a mechanical finishing machine. For the curb and gutter a 1:2:3 concrete mix with a ½-in. mortar top was specified, but as the contractor planned to construct the curb and gutter first and to run the finishing machine along the gutter, the specifications were changed to permit a one-course curb and gutter of slightly richer mix, thus avoiding any cracking of the mortar top.

A central mixing plant was used, with a 1-yd. batch mixer, water-storage device and inundator. Material was delivered in cars and transferred to the bins by a 1-yd. clamshell crane. An approximate 1:2:4 mixture was used for the pavement and the aggregates were mixed for a period of at least one minute and then hauled by truck. The maximum length of haul was ½ mile. Six sacks of cement were used to a batch, to which was added 36 gal. of water when the sand was dry and 34 gal. when the sand was moist. The average daily output of 8-in. pavement was 1,140 sq.yd., with a maximum of 1,655 sq.yd. With the 7-in. pavement the figures were 1,300 and 1,980 sq.yd. respectively.

Test cylinders were made at the mixing plant, numbered and then buried in sand at the site until ready to be tested. In the majority of the slump tests there was a variation of ¾ to 1¼ in., with a minimum and maximum of ½ in. and 1¾ in. respectively. Within the limits of the variation in slump there was no definite relation between



VARIATION IN STRENGTH OF PAVEMENT

the compressive strength and the slump, the compressive strength varying between the same limits at ¾ in., 1 in. and 1¼ in. The average compressive strength was 4,000 lb. and only three cylinders tested below 3,000 lb. per sq.in. One of these, however, was poorly tamped and was honeycombed. The cylinders of the same group from which each of the two others was taken showed well above the minimum required strength. Of the cylinders tested, 80 per cent varied from 15 per cent below to 25 per cent above the average compressive strength. In the total number of cylinders tested six were below 3,300 lb. and eight between 3,500 and 3,300 lb. per sq.in. The maximum variation from the average was 38 per cent above and 25 per cent below the average. These results are shown graphically in the accompanying diagram.

Laboratory tests have established the correct water-cement ratio to be used to obtain concrete of a certain strength, and by requiring a minimum compressive strength in the Mundelein paving specifications the volume of water per sack of cement was necessarily limited. While the contractor under the specifications was allowed considerable choice in the proportion of the aggregates and cement in the mixture, he was nevertheless required to produce a high-grade concrete. The use of such specifications avoids uncertainty as to the strength of the pavement and makes the strength more uniform. In addition to a specified strength, it is essential that the aggregates be mixed in the proper proportions to give a dense, workable mix, for these factors determine the

wearing and weathering qualities of the pavement. The field tests necessary to make concrete under such specifications require but little additional work and are easily made. The pavement cost is no greater than under the ordinary specifications which require a 1:2:3 mixture.

This work at Mundelein was done by the Sternberg-Powell Company, Chicago, under the supervision of Kelker, DeLeuw & Company, engineers.

The Continued Decline of Typhoid in the United States

Journal A.M.A. Reports That Seven Cities Had No Typhoid Deaths in 1927 and Average Rate for 74 Decimated Since 1910

TYPHOID fever for the year 1927 in the cities of the United States having an estimated mid-year population above 100,000 ranged from none in seven cities to from 12.9 to 16 in the four cities showing the highest rates. For the 74 cities reporting figures for 1910 as well as 1927, the decline in that interval was from an average rate of 20.59 to 1.96, the actual total figures being 4,568 to 638, with a population increase from 22.3 to 32.5 millions. Had the 1910 rate prevailed in 1927, the deaths in the latter year would have been 6,686 instead of 638, while for the entire eighteen years deaths at the 1910 rate instead of the actual rates would have given an excess of 66,292 over the actual total. These figures are taken from the *Journal* of the American Medical Association (Chicago) for June 19, which there presents its Sixteenth Annual Report on Typhoid Fever in the Large Cities of the United States. All the tabular data printed in the place indicated is reproduced here through the courtesy of the editor and publishers of the journal named, but to save space some of it has been more compactly arranged.

TABLE I—TYPHOID RANK OF 81 LARGE AMERICAN CITIES IN 1927

Death Rates Per 100,000 Population

Honor Roll: 0.0 to 1.9—43 Cities			
Canton	0.0	Boston	14.1
Kansas City, Kan.	0.0	Norfolk	1.1
New Haven	0.0	Detroit	1.2
Paterson	0.0	Jersey City	1.2
Richmond	0.0	Rochester	1.2
Springfield	0.0	Indianapolis	1.3
Yonkers	0.0	New York City	1.3
Providence	0.4	Newark	1.3
Bridgeport	0.6	Philadelphia	1.4
Camden	0.7	Erie	1.5
Chicago	0.7	Syracuse	1.5
Minneapolis	0.7	Trenton	1.5
Scranton	0.7	Dayton	1.7
Cambridge	0.8	Reading	1.7
Elizabeth	0.9	San Francisco	1.7
Lynn	0.9	Baltimore	1.8
Milwaukee	0.9	Hartford	1.8
Omaha	0.9	Washington	1.8
San Diego	0.9	Grand Rapids	1.9
Spokane	0.9	Pittsburgh	1.9
Cleveland	1.0	St. Louis	1.9
Los Angeles	1.0		
First Rank: 2 to 4.9—26 Cities			
Columbus	2.0	St. Paul	2.8
Flint	2.1	Tacoma	2.8
Portland	2.1	Kansas City, Mo.	2.9
Oakland	2.2	Toledo	2.9
Salt Lake City	2.2	Utica	2.9
Fall River	2.3	Louisville	3.1
Buffalo	2.4	Worcester	3.1
Youngstown	2.4	Wilmington	3.2
Lowell	2.6	Albany	3.3
Duluth	2.7	Des Moines	3.3
Seattle	2.7	New Bedford	3.3
Akron	2.8	Cincinnati	3.9
Denver	2.8	Fort Worth	4.3
Second Rank: 5 to 9.9—8 Cities			
Houston	5.6	Jacksonville	7.2
San Antonio	5.7	El Paso	7.9
Oklahoma City	6.4	New Orleans	8.0
Dallas	6.6	Tulsa	8.7
Third Rank: Above 10—4 Cities			
Birmingham	12.9	Memphis	14.5
Atlanta	14.0	Nashville	16.0

TABLE II—TYPHOID DEATH RATES IN THE 81 CITIES OF THE UNITED STATES WITH OVER 100,000 POPULATION

From the *Journal* of the American Medical Association, June, 1928. The basic typhoid figures were supplied by the respective health departments. Rates per 100,000 computed on mid-year population estimates of the U. S. Census Bureau; for ten cities where such figures were not available local health department estimates are used, as given in footnotes numbered 1 to 10.

	1927	1926	1921-25	1916-20	1911-15	1906-10
1. New England: 12 Cities:						
New Haven	0.0	2.2	4.4	6.8	18.2	30.8
Springfield	0.0	0.7	2.0	4.4	17.6	19.9
Providence	0.4	0.7	1.8	3.8	8.7	21.5
Bridgeport	0.6	0.6	2.2	4.8	5.0	10.3
Cambridge	0.8	4.9	4.3	2.5	4.0	9.8
Lynn	0.9	3.8	1.6	3.9	7.2	14.1
Boston	1.1	1.8	2.2	2.5	9.0	16.0
Hartford	1.8	1.2	2.5	6.0	15.0	19.0
Fall River	2.3	0.8	2.3	8.5	13.4	13.5
Lowell	2.6 (1)	0.9	2.4	5.2	10.2	13.9
Worcester	3.1	0.5	2.3	3.5	5.0	11.8
New Bedford	3.3 (2)	0.7	1.7	6.0	15.0	16.1
2. Middle Atlantic: 18 Cities:						
Paterson	0.0	1.4	3.3	4.1	9.1	19.3
Yonkers	0.0	0.0	1.7	4.8	5.0	10.3
Camden	0.7	4.6	5.9	4.9	4.5	4.0
Scranton	0.7	4.2	2.4	3.8	9.3	31.5
Elizabeth	0.9 (3)	1.0	2.4	3.3	8.0	16.6
Jersey City	1.2	1.9	2.7	4.5	7.2	12.6
Rochester	1.2	4.0	2.1	2.9	9.6	12.8
New York	1.3	1.9	2.6	3.2	8.0	13.5
Newark	1.3	1.5	2.3	3.3	6.8	14.6
Philadelphia	1.4	1.9	2.2	4.9	11.2	41.7
Erie	1.5 (4)	0.8	2.3	6.9	49.0	46.6
Syracuse	1.5	1.1	2.3	7.7	12.3	15.6
Trenton	1.5 (a)	2.2	8.2	8.6	22.3	28.1
Reading, Pa.	1.7	2.6	6.0	10.0	31.9	42.0
Pittsburgh	1.9	2.7	3.9	7.7	15.9	65.0
Buffalo	2.4	5.0	3.9	8.1	15.4	22.8
Utica	2.9	0.0	3.9 (b)	....	....	....
Albany	3.3	0.0	5.6	8.0	18.6	17.4
3. South Atlantic: 7 Cities:						
Richmond	0.0	2.6	5.7	9.7	15.7	34.0
Norfolk	1.1	1.7	2.8	8.8	21.7	42.1
Baltimore	1.8	4.7	4.0	11.8	23.7	35.1
Washington	1.8	2.5	5.4	9.5	17.2	36.7
Wilmington	3.2	2.4	4.7	25.8(c)	23.2(d)	33.0
Jacksonville	7.2	8.8	....	....	....	....
Atlanta	14.0	17.2	14.5	14.2	31.4	58.4
4. East North Central: 14 Cities:						
Canton	0.0	3.6	3.3	7.0 (e)	....	....
Chicago	0.7	0.8	1.4	2.4	8.2	15.8
Milwaukee	0.9	1.7	1.6	6.5	13.6	27.0
Cleveland	1.0	1.4	2.0	4.0	10.0	15.7
Detroit	1.2	2.2	4.1	8.1	15.4	22.8
Indianapolis	1.3	5.4	4.6	10.3	20.5	30.4
Dayton	1.7	2.3	3.3	9.3	14.8	22.5
Grand Rapids	1.9	1.3	1.9	9.1	25.5	29.7
Columbus	2.0	1.7	3.5	7.1	15.8	40.0
Flint	2.1	0.7	4.6	22.7	18.8	46.9
Youngstown	2.4	0.0	7.2	19.2	29.5	35.1
Akron	2.8 (5)	1.5	2.4	10.6	21.0	27.7(f)
Toledo	2.9	4.7	5.8	10.6	31.4	37.5
Cincinnati	3.9	2.7	3.2	3.4	7.8	30.1
5. East South Central: 4 Cities:						
Louisville	3.1	6.7	4.9	9.7	19.7	52.7
Birmingham	12.9	8.5	10.8	31.5	41.3	41.7
Memphis	14.5	19.2	18.9 (g)	27.7	42.5	35.3
Nashville	16.0	35.0	17.8	20.7	40.2	61.2
6. West North Central: 8 Cities:						
Kansas City, Kan.	0.0	4.3	5.0	9.4	31.1	74.5(h)
Minneapolis	0.7	1.4	1.9	5.0	10.6	32.1
Omaha	0.9	1.8	3.3	5.7	14.9	40.7
St. Louis	1.9	2.3	3.9	6.5	12.1	14.7
Duluth	2.7	0.8	1.7	4.4	19.8	45.5
St. Paul	2.8	1.2	3.4	3.1	9.2	12.8
Kansas City, Mo.	2.9	3.5	5.7	10.6	16.2	35.6
Des Moines	3.3	2.7	2.2	6.4	15.9	23.7
7. West South Central: 8 Cities:						
Fort Worth	4.3	10.7	6.1	16.3 (i)	11.9	27.8
Houston	5.6 (6)	6.0	7.6	14.2	38.1	49.5
San Antonio	5.7	7.8	9.3	23.3	29.5	35.9
Oklahoma City	6.4 (7)	....	....	....	....	....
Dallas	6.6	8.9	11.2	17.2	....	....
El Paso	7.9	9.2	10.8	30.7	42.8	....
New Orleans	8.0	18.6	11.6	17.5	20.9	35.6
Tulsa	8.7	14.3	16.2 (j)	....	....	....
8. Mountain and Pacific: 8 Cities:						
San Diego	0.9 (8)	0.9	1.6	7.9	17.0	10.8
Spokane	0.9 (9)	6.5	4.4	4.9	17.1	50.3
Los Angeles	1.0	1.1	3.0	3.6	10.7	19.0
San Francisco	1.7	2.5	2.8	4.6	13.6	27.3
Portland, Ore.	2.1 (10)	2.5	3.5	4.5	10.8	23.2
Oakland	2.2	0.8	2.0	3.8	8.7	21.5
Salt Lake City	2.2	0.7	6.0	9.3	13.2	41.1
Seattle	2.7	2.3	2.6	2.9	5.7	25.2
Denver	2.8	3.5	5.1	5.8	12.0	37.5
Tacoma	2.8	3.8	3.7	2.9	10.4	19.0

(1) to (10). Populations supplied by local health departments: (1) Lowell, 112,759. (2) New Bedford, 121,460. (3) Elizabeth, 113,033. (4) Erie, 131,000. (5) Akron, 210,000. (6) Houston, 284,446. (7) Oklahoma City, 150,000. (8) San Diego 115,300. (9) Los Angeles, 1,200,000. (10) Portland, Ore., 332,835.

(a) Health department states diagnosis doubtful in the two deaths that occurred. (b) Data for 1925 only. (c) 1916 only. (d) Lacks 1913. (e) Lacks 1916, 1917. (f) Data for 1909 and 1910 only. (g) The Memphis typhoid rate for 1924 was erroneously stated in the summary for that year. The average for 1912-25 is here corrected. (h) Lacks 1906, 1907. (i) Lacks 1918 and 1919. (j) Lacks 1921 and 1922.

Text accompanying the original tables comments on some of the changes from year to year, both by cities and groups. For the past three years, the original text states, "there has been a progressive decline in every group," but "1925 was a 'typhoid year.'" In 1927, not only were 41 of the 81 cities on the "honor roll" (0.0 to 1.9 per 100,000) but five of the eight groups had average rates under 2—the three other groups, all Southern, ranging from an average of 3.39 to 10.07.

In commenting on the fact that seven of the 81 cities had no typhoid deaths in 1927, the *Journal* says the record "does not approach" that of Great Britain, where in 1924, fifteen of 48 large cities had no typhoid deaths. (Typhoid in Certain Large Cities of Europe in 1924, *Jour.* A.M.A., Dec. 12, 1895.) Table III (herewith)

TABLE III—ZERO TYPHOID OCCURRENCES, 1919 TO 1927

1919 Spokane	1925 Lowell	1927 Canton
1920 Yonkers	Scranton	Kansas City, Kan.
1922 New Bedford	1926 Albany	New Haven
Providence	Utica	Paterson
Yonkers	Yonkers	Richmond
1923 Norfolk	Youngstown	Springfield
1924 Fall River		Yonkers
Hartford		

Yonkers appears four times: 1920, 1922, 1926 and 1927.

TABLE IV—TYPHOID DEATHS FOR 74 CITIES, 1910-27 TOGETHER WITH YEARLY DEATHS AT 1910 RATE*

	Population	Deaths	Rate per 100,000	Deaths at 1910 Rate	Exceeding Actual Number of Deaths by
1910	22,286,000	4,586	20.58	4,586	0
1911	22,916,700	3,883	16.94	4,716	833
1912	23,535,450	3,077	13.07	4,844	1,767
1913	24,151,936	3,222	13.34	4,970	1,748
1914	24,776,777	2,744	11.07	5,099	2,355
1915	25,392,422	2,374	9.34	5,227	2,854
1916	25,928,745	2,154	8.31	5,336	3,182
1917	26,528,213	1,963	7.40	5,468	3,505
1918	26,737,190†	1,796†	6.72	5,502	3,706
1919	27,373,579†	1,141†	4.17	5,633	4,492
1920	28,182,528	1,074	3.81	5,800	4,726
1921	28,509,732	1,130	3.96	5,867	4,737
1922	28,947,007	955	3.30	5,957	5,002
1923	29,580,000	936	3.16	6,087	5,151
1924	30,155,014	937	3.11	6,201	5,264
1925	30,938,501	1,067	3.45	6,367	5,300
1926	31,667,424	895	2.83	6,517	5,622
1927	32,492,123	638	1.96	6,686	6,048
				100,863	66,292

* Of the 81 cities included in the 1927 tables six are omitted here because data for the full period are lacking: Canton, Dallas, Jacksonville, Oklahoma City, Tulsa, Utica, Wilmington.
† Fort Worth data lacking.

TABLE V—TYPHOID DEATHS AND RATES FOR LAST THREE YEARS BY GEOGRAPHICAL DIVISIONS

	Population	Rates Per 100,000 Population					
		1927		1926		1925	
	1927	Deaths	Rate	Deaths	Rate	Deaths	Rate
New England	2,540,209	32	1.26	38	1.51	58	2.37
Middle Atlantic	11,789,633	166	1.41	243	2.09	349	2.97
South Atlantic	2,244,300	76	3.39	120	5.38	117*	5.71*
E. North Central	8,319,500	109	1.31	137	1.69	174	2.19
E. South Central	854,300	86	10.07	121	14.47	111	14.30
W. North Central	2,520,400	47	1.86	55	2.22	81	3.31
W. South Central	1,698,946	114	6.71	173†	11.69†	190†	13.27†
Mountain and Pacific	3,508,435	61	1.74	68	1.98	73	2.19

* Lacks data for Jacksonville. † Lacks data for Oklahoma City.

Geographical Group Rates According to Rank—Rearranged by *Engineering News-Record*

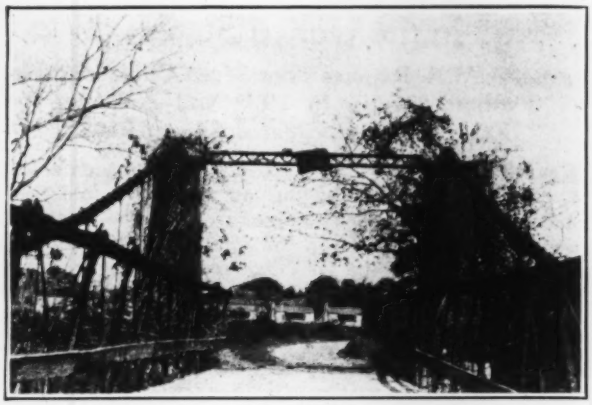
	Population	Typhoid Rates per 100,000		
	1927	1927	1926	1925
New England	2,540,209	1.26	1.51	2.37
East North Central	8,319,500	1.31	1.69	2.19
Middle Atlantic	11,789,633	1.41	2.09	2.97
Mountain and Pacific	3,508,435	1.74	1.98	2.19
West North Central	2,520,400	1.86	2.22	3.31
South Atlantic	2,244,300	3.39	5.38*	5.71*
West South Central	1,698,946	6.71	11.69	13.27†
East South Central	854,300	10.07	14.47	14.30

* Lacks data for Jacksonville. † Lacks data for Oklahoma City.

lists 21 zero typhoid occurrences from 1919 to 1927 in eighteen different cities, Yonkers, N. Y., appearing four times and the other cities only once each. In 1924, only two large American cities had no typhoid deaths, compared with the fifteen in England, already mentioned.

Passing of Old Mississippi Bridge

A suspension bridge located at Port Gibson, Miss., which was used by Union troops on their approach to the siege of Vicksburg after the battle of Port Gibson, was recently demolished. The structure, shown in the accompanying illustration, had cables made up of several layers of $\frac{1}{4}$x4$\frac{1}{2}$-in. strap iron with bands about a foot apart anchored in brick masonry. The towers were of riveted plates and were circular in section. The



OLD MISSISSIPPI SUSPENSION BRIDGE RECENTLY DEMOLISHED

stiffening trusses, says Sam Stone, to whom *Engineering News-Record* is indebted for the information and photograph, "are evidently of more recent construction, being made up of rolled steel channels and rods." The older portions of the bridge were in good condition. The span was approximately 150 ft. and the width 10 ft.

Carquinez Bridge Causes Traffic Increase

A larger number of vehicles crossed the great bridge over the Carquinez Strait at the upper end of San Pablo Bay during 1927 than used the ferry at the same point during 1926. The exact figures are 395,843 by ferry in 1926 and 677,389 vehicles by bridge in 1927, as reported in the San Francisco Bay bridge hearings before the committee on interstate and foreign commerce of the House of Representatives. While the percentage of increase of 1927 over 1926 traffic was 71, all of this increase cannot be attributed to the presence of the bridge, since there has been a constant growth in ferry traffic between San Francisco and the east bay cities for a number of years. The increments of increase in ferry traffic since 1921 are as follows: for 1921, 6.9 per cent; for 1922, 12.7 per cent; for 1923, 31.1 per cent; for 1924, 9.6 per cent; for 1925, 14.6 per cent; for 1926, 74.3 per cent; and for 1927, 30 per cent. This is an average increase of about 15.6 per cent per year over the seven-year period.

Assuming that the Carquinez bridge had not been built, this average increase would have occurred in the ferry traffic near its site, raising it from 395,843 to 455,319. The latter is the figure to be used in determining the probable effect of the bridge on traffic. Actual bridge traffic of 677,389 during 1927 represents an increase over this figure of 222,070 vehicles, or 48.7 per cent, which can probably be attributed to the presence of the bridge.

Rebuilding a Toll Bridge in Service

Twin-Channel Steel Bridge Doubled in Capacity by Moving One Channel Crossing Alongside the Other and Filling the Gap With Concrete Arches

By Charles E. Modjeski
Assistant Engineer, Market St. Bridge, Harrisburg, Pa.

AN UNUSUAL variety of operations was required in rebuilding recently the toll bridge across the Susquehanna River at Forster's Island on the line of Market St. in Harrisburg, Pa. The old bridge, a plate-girder structure, crossed each of the two channels, formed by the island, in sixteen spans. It was required to shift the east channel spans to the west channel and re-erect them alongside the west channel spans, and in their place in the east channel to construct a sixteen-span stone-faced concrete arch bridge. Also, as the bridge was a toll bridge, it was required that all the work should be done without interrupting, or even discouraging, traffic in the use of the crossing. All construction planning had to be premised on these two requirements.

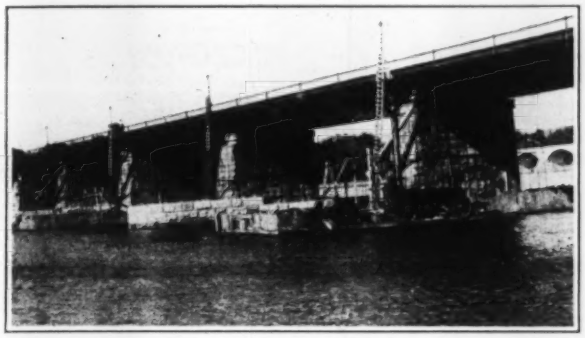


FIG. 1—OLD PLATE GIRDER TOLL BRIDGE AT MARKET STREET, HARRISBURG, PA.
Piers being incased with larger, stone-faced concrete piers to carry new arch spans with roadway double the width of the old bridge.

As the plans were worked out the following operations were involved: (1) Incasing and enlarging the old east channel masonry substructure to carry a superstructure twice as wide as the old girder spans; (2) widening the old west channel masonry substructure to carry the girder spans moved from the east channel; (3) shifting sidewise on the widened substructure the east channel girder spans to carry traffic and give room for constructing half the width of the concrete arch spans; (4) constructing the concrete arch bridge to half width and diverting traffic to it; (5) moving the east channel girder spans to the west channel and erecting them on the widened substructure; (6) constructing the second half of the east channel arch bridge. These operations, it will be understood, overlapped in time and order, but as numbered, they define the separate processes of reconstruction.

Old and New Structures—The bridge being reconstructed is the successor of several structures, the first of which was a camel-back wooden bridge of six spans in each channel, constructed in 1816. The latest bridge consisted (Fig. 1) of half-through plate-girder spans, 18 ft. wide between curbs and 20½ ft. wide between centers of girders, with an 8-ft. sidewalk on the upstream side. Sixteen spans were built in each channel, the distance between centers of piers being 88½ ft. in the east channel and 89 ft. 2 in. in the west channel. The piers were built of sandstone and measured about 25x6 ft. under the copings. The steelwork was furnished by the Pennsylvania Steel Company, of Steelton, Pa., and the bridge was opened to traffic in 1904. The following year, 1905, 246,400 vehicles crossed the bridge. In 1920, 1,000,000 vehicles crossed the bridge.

In 1925 it was decided to replace the section over the east channel with a stone-faced concrete arch bridge, providing a 40-ft. roadway and two 6-ft. sidewalks; and to move the steel spans from the east channel to a position parallel to and just downstream from the west channel spans. This arrangement gives a 40-ft. roadway over the east channel and Forster's Island, a distance of about 2,200 ft., and two 18-ft. roadways over the west channel, one for traffic in each direction. The arch spans of the east channel are of the same length, 88½ ft., as the former steel spans. The new piers are 12 ft. wide at the springing lines, with a length of almost 80 ft.

Pier Construction—In the west channel, pier construction consisted simply of extending the old piers downstream, with concrete. In the east channel, pier construction was a progressive operation as shown by Fig. 2. Here the center line of the new bridge is about 5½ ft. upstream from that of the old. The old piers were therefore completely incased by the new ones. Bedrock in the east channel was found at from 5 to 10 ft. below low water. Open cofferdams (Fig. 1) were used for placing the foundations of the new piers and abutments. At the points where the new piers came on the same location as the original piers of the camel-back bridge some difficulty was encountered in sealing the cofferdams, as the sheeting was held up off the rock by timbers which had been used in the crib-type footings of the old piers. Some of these timbers were 16x16 in. and,

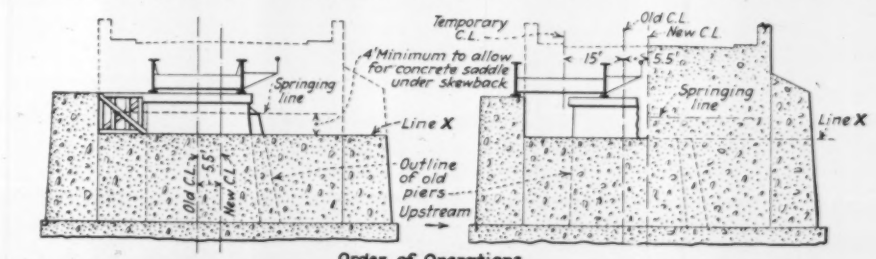

Temporary C.L.
Old C.L.
New C.L.
4' Minimum to allow for concrete saddle under skewback
< 15'
5.5'
Springing line
Springing line
Line X
Line X
Outline of old piers
Upstream
Old C.L.
New C.L.
5.5'
Order of Operations
1-Built shaded portion of new piers encasing old piers up to line X
2-Placed bents as shown
3-Moved steel spans 15' downstream
4-Removed old piers to line X, upstream from new C.L.
5-Completed upstream half of new bridge
6-Move steel spans to west channel
7-Remove remainder of old piers down to line X
8-Complete new bridge

FIG. 2—SEQUENCE OF BRIDGE REPLACEMENT OPERATIONS

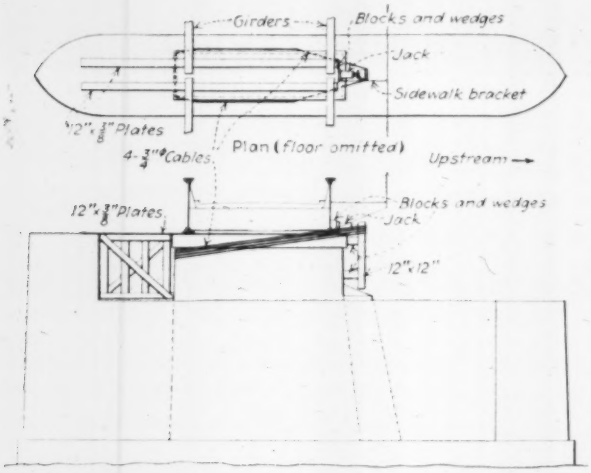


FIG. 3—TACKLE AND JACKS FOR SLIDING ASIDE OLD SPANS

having been continually under water, were excellently preserved after 110 years. Some wrought-iron clamps were also found in practically perfect condition.

Shifting East Channel Spans—To maintain traffic during the reconstruction of the bridge it was decided to build the upstream longitudinal half of the new bridge before moving the steel spans to their new position in the west channel. To secure proper clearance for the erection of the upstream half it was necessary to move the steel spans downstream about 16 ft. to a temporary position (Fig. 2). This placed the sidewalk of the steel spans just downstream of the new center line. In order not to damage the expansion joints between each two of the sixteen spans and incidentally in order not to discourage traffic, the sixteen spans were moved simultaneously. The spans were jacked up, and long

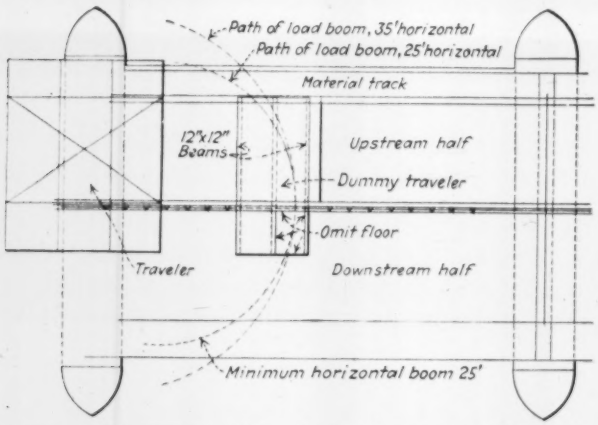


FIG. 4—TRAVELER FOR PLACING ARCH CONCRETE
Traveler operated on old girders to pour concrete in upstream half of new bridge, then shifted to new bridge for pouring the downstream half.

12x⅞-in. plates were placed under all the sole-plates to act as skids on which the spans could slide. Jacks were then placed at each pier and abutment, as shown in Fig. 3, with a gang of men assigned to each jack.

One white and one red flag was furnished to each gang. At a given signal from the foreman in charge all the jacks were put in operation at the same time. As soon as any gang had moved its end of the spans 2 in. it stopped jacking and displayed the white flag. When white flags showed at every pier and both abutments, the foreman gave the signal to proceed, the flags were taken in, jacking was resumed for another 2 in., and so on. The red flag was used by any gang which had trouble of any kind as a signal to the foreman not to proceed until the trouble was remedied. In this way the sixteen spans were moved practically as a unit, no end of any span ever being more than 2 in. ahead of or behind any other span.

Some difficulty was encountered with the two end spans, which had a tendency to wedge themselves tightly against the back-walls of the abutments whenever the

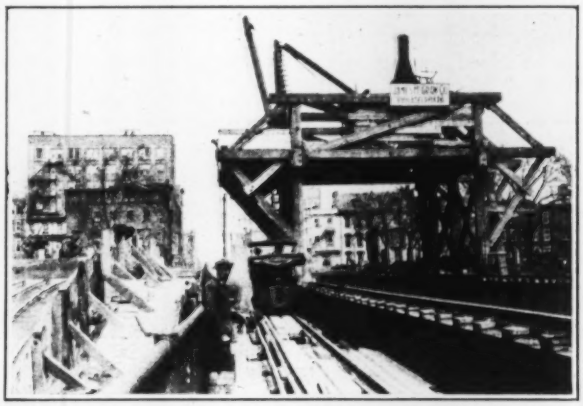


FIG. 5—TRAVELER SERVICE TRACK AND ARCH CENTERS READY FOR PLACING CONCRETE

off-shore end got slightly ahead of the shore end. It was soon found that this trouble could be overcome by keeping the shore ends slightly ahead of the off-shore ends—that is, by moving the shore end ahead until the upstream-shore corner jammed against the back-wall the additional movement of the other end tended to release the jammed corner so it could be moved farther, etc.

The entire operation of moving the bridge took five days, with no interruption to traffic. The approaches had been prepared beforehand, with cable fences and 12x12-in. timber curbs leading onto the bridge from the approaches, so that at no time was there danger of a vehicle running into the river instead of onto the bridge.

Arch Span Construction—The new bridge consists of barrel arches of concrete faced with stone. To build the upstream half a narrow-gage track was built on the sidewalk of the girder bridge and connected with a track system on the island, where the contractor's mixing plant and stone yard were located. Then a traveler, constructed as shown by Fig. 4, was mounted on the old girders and handled the material from cars to the work by a stiff-leg derrick mounted on one inside corner. The

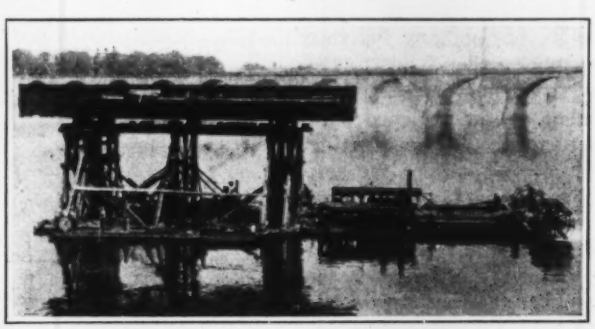


FIG. 6—SHIFTING OLD EAST CHANNEL SPANS FOR RE-ERECTION IN WEST CHANNEL

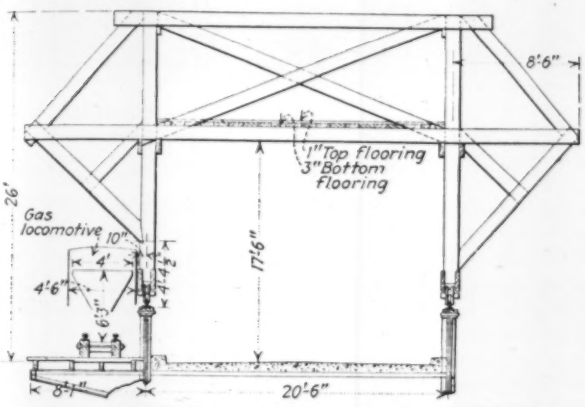


FIG. 7—DUMMY TRAVELER ARRANGEMENT TO PROTECT TRAFFIC

relative location of the new work the traveler and the track are shown by Fig. 5.

As soon as the upstream half of the new bridge was completed and traffic was turned onto it the old steel spans were floated around to the other channel, as shown by Fig. 6, turned end for end, in order to bring the sidewalk on the downstream side, and placed in their new position on the concrete extensions of the old west channel piers. The traveler shown in Fig. 4 was then run over the completed upstream half of the arch bridge to handle material for the downstream half. The work-train ran on the upstream sidewalk of the new bridge, so that all materials had to be carried across the roadway by the traveler, from the upstream to the downstream side. In order to protect traffic on the roadway, a "dummy" traveler (Fig. 7) was built, with a heavy floor which would act as a roof over the roadway. This dummy was kept directly under the path of the end of the boom on the main traveler, so that any material that was spilled while being carried across the roadway would fall on the floor of the dummy instead of on the traffic beneath.

The special features of the bridge concreting were the method of handling the arch centers and the method of concrete control. Steel truss centers with wood lagging were used. A center was assembled complete with lagging and erected as shown by Fig. 8, which also indicates the stone facing of piers and arch ring. The special feature was the barge handling and erection. To strike a center it was lowered onto staging on a barge and shifted to its new location as shown by Fig. 9. To erect the center for a new arch the barge was flotated between piers and the end supports erected under the jacked-up center. When the center was resting on the

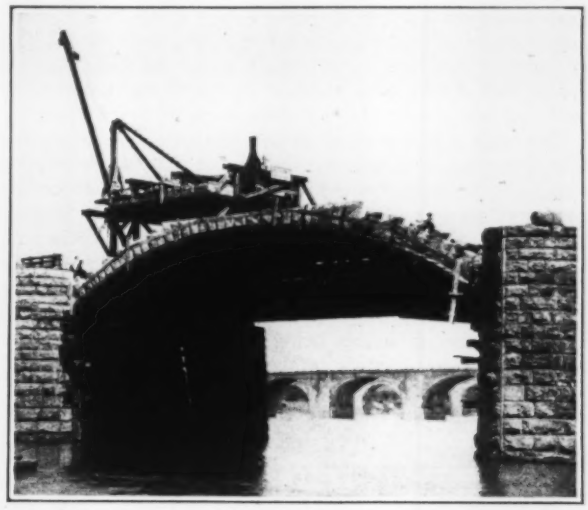


FIG. 8—STEEL CENTERS FOR CONCRETE ARCHES

supports the barge was floated out and concreting proceeded.

An unusual procedure was followed in concrete control for the arch rings. A 1:2:4 mixture was specified with a minimum strength in compression of 2,000 lb. in 28 days as determined from 6x12-in. cylinders. Each arch ring was poured in three sections; the two haunch sec-

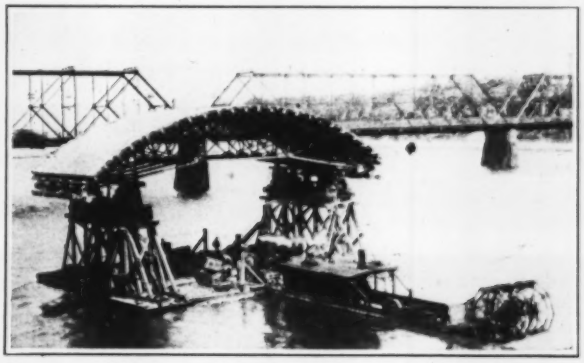


FIG. 9—SHIFTING CENTER TO NEW ARCH SPAN

tions on either side were poured, then sections above the spining line, and then the crown section. In each section a capped length of pipe, with capped end down, was set in the concrete so as to reach about half through the ring. The top end of each pipe was threaded for a plug, which was removable, so that a thermometer tube

STRENGTH AND AGE OF CONCRETE FOR STRIKING ARCHES

	Date Concreted			Cone. to Air Temp.					
Arch	First Half	Second Half	Date Struck	Age, Days	Strength, Lb./Sq.In.	Age, Days	Strength, Lb./Sq.In.	Age, Days	Strength, Lb./Sq.In.
1	Mar. 26, 1927	Mar. 30, 1927	Apr. 19, 1927	19	1,763	19	1,901	28	2,168
2	Apr. 11	Apr. 13	Apr. 30	16	1,450	16	2,469	28	2,320
3	Apr. 15	Apr. 18	May 4	15	2,660	15	2,867	28	3,144
4	Apr. 19	Apr. 21	May 7	15	1,434	15	2,594	28	2,113
5	Apr. 29	May 2	May 17	14	1,747	14	2,070	28	2,060
6	May 7	May 9	May 24	14	1,706	14	2,178	28	2,473
7	May 11	May 13	June 1	18	2,261	18	2,510	28	2,791
8	May 16	May 19	June 3	14	1,978	14	2,542	28	2,896
9	May 23	May 25	June 9	14	2,120	14	2,266	28	2,433
10	June 2	June 6	June 20	13	1,763	13	2,153	28	2,543
11	June 7	June 9	June 23	13	1,766	13	2,126	28	2,843
12	June 8	June 10	June 24	13	1,705	13	1,913	28	2,498
13	June 13	June 16	June 30	13	2,268	13	1,820	28	2,090
14	June 22	June 24	July 9	14	2,637	14	2,032	28	2,466
15	June 27	June 29	July 14	14	1,829	14	2,148	28	2,684
16	June 28	June 30	July 16	15	1,916	15	2,162	28	2,507
					Av. 1,937		Av. 2,234		Av. 2,497

Coarse aggregate, crushed limestone. Fineness modulus, 7.87. Proportions, nominal 1-2-4. Fine aggregate, washed sand. Fineness modulus, 3.18.

could be inserted in the pipe to take temperature readings, showing the temperature of the interior of the concrete. Readings were made every morning at the same hour, or as much oftener as was thought desirable, and simultaneously the air temperatures were read.

Concrete was deposited at not less than 60 deg., great care being taken in cold weather to see that this minimum was not decreased. As the concrete was deposited cylinders were molded, generally three for each haunch and crown section. The concrete for these cylinders was taken from the batches being poured and not from the mixer. As the arch ring concrete aged the concrete and air temperature curves were plotted to the same coordinates, the ordinates being the age in days and the abscissas being degrees temperature. As the concrete set and hardened, heat was developed and the temperature curve for concrete rose and remained above air

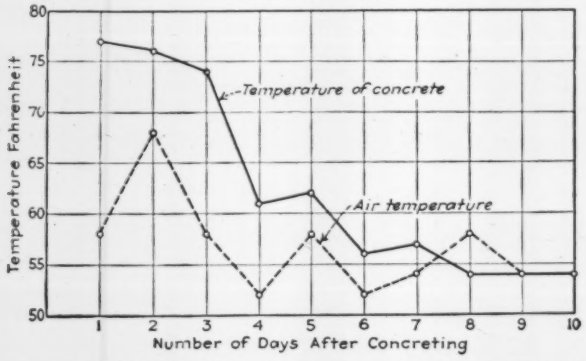


FIG. 10—CHART OF CONCRETE TO AIR TEMPERATURES

temperature until chemical action slackened and the air and the concrete temperature curves converged. Fig. 10 shows the average curves for sixteen arches and illustrates the phenomenon indicated. When the curves met, generally in nine to fourteen days, it was considered permissible to strike the center; a crushing test was made to confirm the temperature indication. Again when the center was struck a cylinder was crushed and finally a third was crushed in 28 days. The accompanying table shows the time and age records for all arches.

Direction—The bridge was reconstructed for the Harrisburg Bridge Company under the direction of Ralph Modjeski and Frank M. Masters, engineers, assisted by Paul P. Cret, architect, and C. Glennon Melville, resident engineer. The work was done by the James McGraw Company, Philadelphia, Pa., with William Cullinane as superintendent.

Alberta Tar Sand Deposits to Be Developed

Development on a large scale of the tar sand deposits of Fort McMurray, Alberta, by the Imperial Chemical Industries, Ltd., a wealthy British concern of which Sir Alfred Mond is president, is likely in view of the fact that this company recently obtained an option on 12,000 acres of land, known as the Hammerstein and Athabasca oil and asphalt properties, lying between Fort McMurray and Fort McKay. Experiments will probably be conducted with a new process tried out last summer in Germany with much success in the extracting of oil from the tar sands. Experiments in the use of these sands for surfacing highways are under way in Canada.

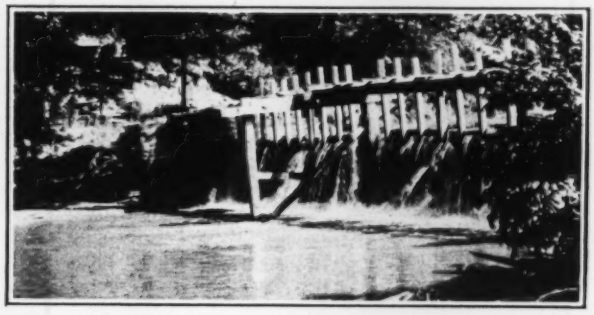
Timber Dam Intended to Fail During High Water

Light Post and Plank Construction Provides Low Head and Storage, but Clears Channel for Heavy Flow

AN OLD timber dam of curious construction for a small hydro-electric plant on the Kickapoo River at LaFarge, Wis., was brought to notice recently by news of its partial failure in a flood, and inquiry develops that such failure, with consequent repair, is of rather frequent occurrence.

This dam, in a rock channel, is 60 ft. long between abutments and consists of a top and bottom sill supporting 4x5-in. posts, against which are placed 1-in. planks on edge, giving a head of 6 to 8 ft. At the middle it is reinforced by a timber bent or horse, as shown in the accompanying illustration. The dam was built about 1862 to serve a sawmill, but this mill was discontinued some years ago, and when a hydro-electric plant was established to furnish electric current for the village, this old dam was retained in practically its original condition. The power house is at some distance from the dam, taking the water through a flume and having a head of about 10 ft. Its plant consists of an old 37½-kw. generator and a new 94-kva. generator, both belted to a line shaft. The output is in the neighborhood of 100,000 kw.-hr. per year.

An official statement as to the dam says: "This construction is rather temporary and has been known to wash out several times in a single season." As the pool is confined to the banks of the stream, there is little loss of storage water and little damage is done along



WOOD DAM FOR SMALL POWER PLANT
During high floods the flashboards in the middle are washed away.

the river, but the village is without electric power until the dam is repaired. During high floods the water overflows the south bank and makes a cutoff, entering the channel again below the power house. In order to limit this overflow, it is necessary to have the face of the dam composed of flashboards which can be removed or will be carried away.

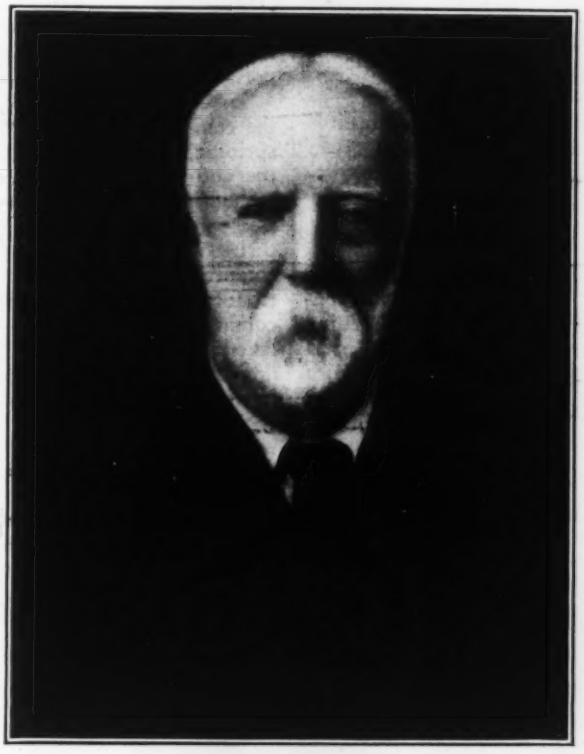
After the recent washout the local electric company engaged Mead & Seastone, Madison, Wis., as engineers to study the situation. A concrete dam was proposed, but with the small demand for power it is thought that the company cannot afford such an improvement. An alternative plan is to rebuild the dam on the old design, but to increase its length to 90 ft. and to provide for ready removal of the entire face by making it of flashboard panels.

75 Years in Railroad Construction

Passing of Henry J. Cambie Ends Active Career of an Outstanding Figure in the Northwest

WITH the death on April 23, 1928, of Henry J. Cambie there passed an outstanding figure in the field of railroad location and construction in the Northwest; a sturdy figure of a man who up to the last took an active interest in his daily work, though that work had extended over a period of more than three-quarters of a century.

In the early days of Western railroad construction the engineer in charge of work some 2,000 miles from headquarters carried an amount of responsibility that is now little understood. Keeping on friendly terms with Indian tribes, for example, was often a problem of great importance, calling for a brand of diplomacy that is now a lost art; maintaining a supply train service through an uncharted wilderness was vital to the life of the party, and there was always the need for a leader who could keep up esprit de corps in the wilderness and through the long Northern winters—these were only a few of the requirements that called for sterling characters and vigorous personalities in those who carried the responsibilities of the early days.



Henry J. Cambie

Such a man was Henry J. Cambie, who was put in responsible charge of work in British Columbia for the Canadian Pacific Railway when the reconnoissance and preliminary surveys were undertaken. It was he who convinced the authorities at Ottawa of the suitability of Vancouver as a terminal port and it was his genius that found a feasible route through the Fraser River Canyon and then directed the location and construction of the railroad along that route to the Pacific Ocean.

Many engineers came and went in Mr. Cambie's time, but he developed a great love for the Northwest and continued to find a pleasure in his work and a delight in the Northern woods that seemed to keep him young. All these years he remained "on the job," never tiring and always showing that ability in directing his work that is born only of enthusiasm and the love of calling.

Mr. Cambie was born in Tipperary, Ireland, in 1837 and emigrated to Canada when only fifteen years old. In 1852 he entered the office of Walter Shanley, then one of the foremost engineers of Canada, who was directing the engineering work on the Toronto & Guelph Railway (afterward absorbed by the Grand Trunk). Later, in the employment of Gzowski & Company, Mr. Cambie worked on the construction of the Grand Trunk Railroad between Toronto and Detroit. He then spent several years in Nova Scotia as agent for Punchard, Clark & Company, for which firm he located and constructed the Windsor & Annapolis Railway. This road was finished in 1869, and from 1870 to 1873 Mr. Cambie had charge of construction on the Intercolonial Railway, both in New Brunswick and in Quebec. Prior to this time he had done nearly all the exploring for this railway and had made a special study of the district between the St. Lawrence and Bay Chaleur. From 1876 to 1880 Mr. Cambie was in charge of government surveys in British Columbia and in those four years was almost constantly exploring in districts of which very little was known. During this period he was directed by Sir Sanford Fleming, chief engineer of Canadian government railways, to make a reconnoissance of the Fraser River Canyon. This was after other engineers had reported that the idea of adopting this route was not worth a survey. Mr. Cambie satisfied his superiors that such a route was practical and that Burrard Inlet was a suitable harbor. In order to supplement and support the selection of the Fraser River route, in 1878 he conducted a reconnoissance up the Skeena River and down the Peace and Pine rivers on the east of the Rockies.

When construction was started on the Canadian Pacific Railroad from the Pacific Coast end, Mr. Cambie took charge of the work. Because of the great difficulty and delay in communicating with Ottawa at this time the burden of all decisions in this very difficult section of the line rested entirely with him, and in this capacity his service to the company was of a very high order.

Work in the Fraser River Canyon was successfully completed in 1884, after which Mr. Cambie went to Kamloops and took charge of construction between Savona and Shuswap Lake. The line being constructed westward from Winnipeg met Mr. Cambie's division at Craigellachie in November, 1885, and on this occasion the last spike was driven by Lord Strathcona in the presence of Sir Sanford Fleming, Mr. Van Horn, Major Rogers

and a few others, most of whose names have since become famous.

The Canadian Pacific Railway was first operated into Port Moody as a Pacific Coast terminus in 1886. Later, an act of Parliament made Vancouver the terminus, and Mr. Cambie located a line to that point over which trains were operated in May, 1887.

From that time until his death Mr. Cambie continued in the employ of the Canadian Pacific Railway in important engineering capacities. In 1920 his title became consulting engineer, and although subsequent to that date he did not take sole responsibility on any particular work, nevertheless he continued to be regularly at his office in the C.P.R. depot at Vancouver and participated in all engineering councils.

On May 23, 1927, he was guest of honor in Vancouver's celebration of the 40th anniversary of the arrival of the first C.P.R. train.

Glasgow Hall Utilizes Concrete Arches of 110-Ft. Span

Roof Structure of Kelvin Hall, Glasgow, Made Up of Series of Bowstring Arches—Secondary Stresses Important

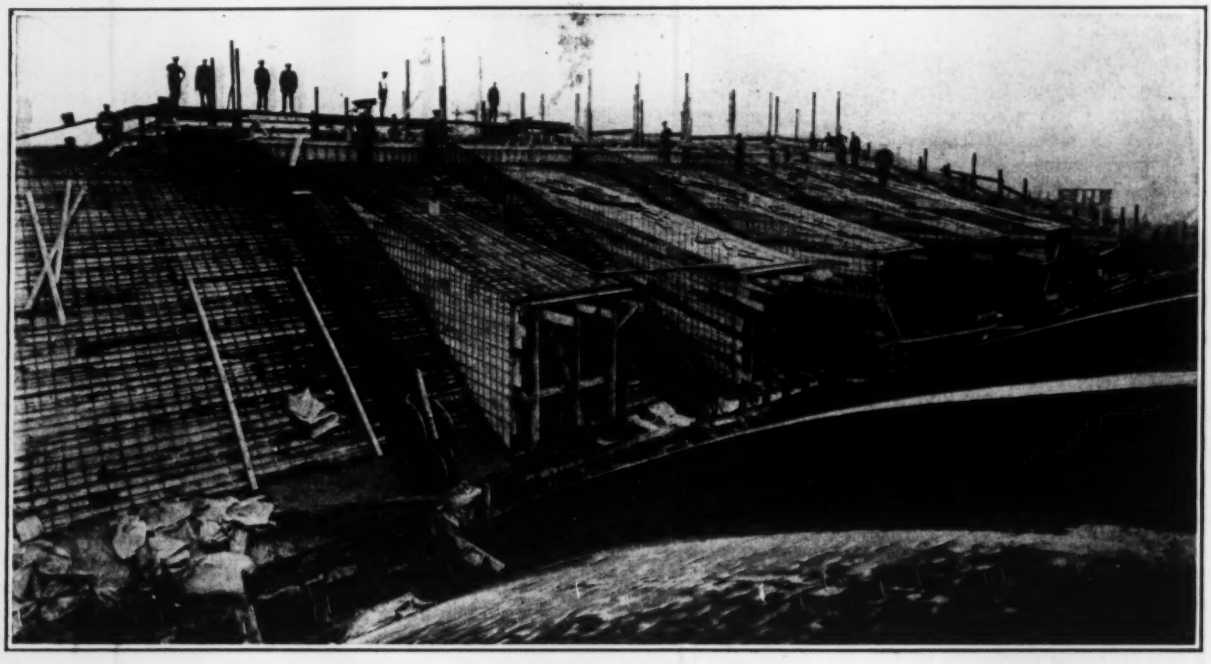
By W. L. Scott
Considere Constructions, Ltd., London, England

PRINCIPLES governing the design of reinforced-concrete arch bridges have been applied in the construction of Kelvin Hall, a new exhibition building recently completed in Glasgow, Scotland. The main roof, supporting columns and foundations, together with the framework of the adjacent administration block, are in reinforced concrete, though the work in the main hall is detached from surrounding construction.

The main hall spreads over an area of 171,000 sq.ft. and is covered by three roof spans of 110 ft. each and one of 60 ft. The lengths normal to the spans are 458 ft. and 331 ft., respectively. Few columns, of as small a sectional area as was compatible with strength, were desirable features, in order to give all the exhibition space possible. In this large area there are but 22 columns; they are of reinforced concrete, octagonal in section and with a diameter of 24 in.

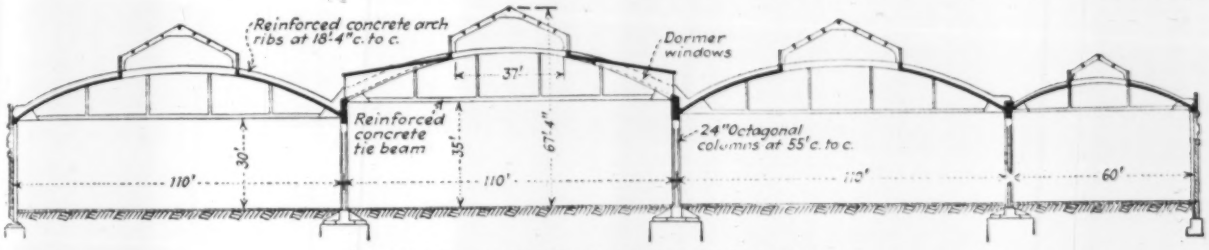
The main roof trusses are composed of arch ribs, ties and vertical hangers or suspenders. The ribs are true arch members, the thrust being taken by the ties connecting the springings. In designing these members several important points arose. In the first place it was necessary to consider carefully the secondary stresses. In spans of this size these effects are of first importance. The elastic extension of the horizontal tie induces deformation of the arch rib. There is a further deformation of the arch rib caused by its elastic shortening when compressed, and also that due to the shrinking of the concrete during setting. All these effects are cumulative and the stresses they produce are permanent throughout the life of the structure; they are therefore of vital importance in the design of such work.

The second point of importance in such construction is the connection of the arch ribs and ties and columns at springing level. Over a relatively small area of material the entire horizontal component of thrust from a rib, amounting in the case cited to about 86 tons, has to be transmitted to the tie, while the vertical component of the thrust must be brought on to the columns without any eccentricity. If eccentricity were allowed, it would introduce intense and unknown stresses at the heads of the columns. The tension in the ties is considered to be taken wholly by the steel reinforcement. This, however, does not mean that concrete surrounding the reinforcement acts only as a protective cover. On the contrary, without the concrete the tie could not function, since it was not possible practically to procure rods of sufficient length to span from end to end without a break. With



REINFORCEMENT IN PLACE FOR VAULT SLAB

a tension member of such a relatively small cross-section as 9x13½ in., containing many rods of large diameters, the old method of lapping the rods and terminating them with hooks is not practicable or even technically desirable. Instead a system of butt joints for the reinforcement has been arranged in such a way that at any cross-



CROSS-SECTION THROUGH MAIN EXHIBITION HALL

section the requisite efficient sectional area of steel is present to keep the tensile stress in the member within the prescribed limits.

The detailed calculations of the main roof principals were based on the design of bowstring girders having a negligible moment of inertia in the tie. In this way all the bending moments produced by the vertical loading, temperature, shrinkage effects, etc., were taken entirely by the arch ribs. These members are 16 in. wide and 32 in. deep from the arch springing to the roof lights, decreasing to 16x24 in. across the center portions. Under the roof lights, which are 40 ft. wide, the ribs are unsupported in the lateral direction, and as these were only 16 in. wide, the working stresses were kept low to prevent any tendency to buckle.

The main 9x13½-in. ties were given a permanent camber of 3 in. to prevent any appearance of sagging and a further 3 in. to allow for the settlement of the staging during construction and of the principal roof members after completion. These ties are supported vertically at 20 ft. intervals by hangers 6x9 in. in thickness. The hangers do not contribute generally to the strength of the bowstring.

During construction special care was required to obviate undue distortion of the curved vault slab, which might result in unsightly, although not structurally dangerous, hair cracks. It was obviously impracticable to release all of the staging simultaneously, so in carrying this out piecemeal, certain roof trusses were subjected to their final deformation under load while others remained supported, causing longitudinal bending in the concrete construction between the trusses in question.

In designing the external wall columns allowance had to be made for the lateral movements taking place at column heads as a result of the roof ties extending under stress. To facilitate the contractor's operations the center 110-ft. span was omitted until the spans on either side were concreted. The total continuous length of the tiebeams is 390 ft., and when subjected to the calculated maximum stress, the possible lateral displacement at their ends was estimated to be about 1.2 in. The external columns were therefore designed to accommodate such a movement, though in fact such a displacement was not realized owing to the absence of the presumed superimposed loading; also the rigidity of the intermediate supporting columns tended to lessen the calculated movement.

Concrete of a 1 : 1½ : 3 mix was used for all reinforced work excepting the interior octagonal columns, which were constructed with a richer mix. Upon completion of concreting and the removal of the staging the interior visible concrete surfaces were rubbed down and washed with a mixture of white cement and cream colored sand.

INTERIOR VIEW OF COMPLETED EXHIBITION HALL

Work Begun on Vehicular Tube From Detroit to Windsor

Tunnel Under the Detroit River Is to Be Partly Shield Driven and Partly of Preformed Sections

CONTRACTS have been let and work has begun on the construction of a vehicular tunnel between Detroit, Mich., and Windsor, Ont., the first international traffic link of its kind ever built. It will be a single tube slightly larger in cross-section than the Holland Tunnel at New York, but of less length, being approximately 5,000 ft. portal to portal. The tunnel will extend from a terminal in the business section of Detroit south under the Detroit River to a similar terminal in Windsor.

Due to the international character of the traffic to be handled, elaborate terminal facilities are required at each end in order to keep the customs and immigration inspection from cutting down the traffic capacity of the tunnel. These facilities are to be provided for within the terminal buildings, which will, for the present at least, be low structures built simply for this purpose and for the accommodation of the customs and immigration officers. The buildings housing the ventilating machinery will be located well inland, within the terminal areas.

The Detroit terminal area is to be the block bounded by Woodbridge, Atwater, Bates and Randolph Sts. This is one block east of the foot of Woodward Ave., the main traffic artery of the city. In Windsor the terminal area is to be located between Wyandotte and Park Sts., Oulette Ave. and a proposed extension of Cartier Place, a location close to the center of the business district.

Three Types of Construction

Three types of construction are to be used in the tunnel. The river portion, 2,500 ft. long between the bulkhead lines, where there will be little or no cover, is to be of 248-ft. sections, partly built up on land, floated to the site and sunk in an excavated trench on the river bottom. The flanking sections, approximately 1,000 ft. and 500 ft. in length respectively, will be shield driven, and the portal sections will be built in open cut.

Both the mid-river portion and its shield-driven approaches are to be of structural steel and reinforced concrete in contrast to the cast-iron and reinforced-concrete construction used on the Holland Tunnel and the reinforced-concrete units built for the Oakland Estuary tube in California.

The 248-ft. units making up the mid-river portion, as built for launching, are to be 31 ft. in diameter and made up of an exterior shell of ⅜-in. welded steel plate lined with a ring of reinforced concrete to give a wall thickness of 18 in. and an internal diameter of 28 ft. Welded to the outside of the steel shell at 12-ft. intervals are to be deep flanges, octagonal in exterior outline, to which are to be fastened the wooden forms surrounding the whole unit. The units are to be launched with the wooden forms in place, the ends of the tubes proper being bulkheaded to provide an air chamber for buoyancy. They will be sunk to a prepared bed in a trench excavated across the river, and when in position tremie concrete will be placed in the space between the outside wooden forms and the steel shell of the tube. This arrangement will give an additional layer of concrete approximately 2 ft. thick outside of the steel shell.

The cross-section of the shield-driven portion of the tunnel is to be somewhat larger than the ring section of the preformed units. It will have an interior diameter of 28 ft. 4 in. and a wall thickness of 2 ft. of reinforced concrete. The rings by which the shield-driven sections are to be built up are a radical departure from earlier types used in shield-driven tunnels. They are to be 2 ft. 6 in. long, made up of an outside steel plate ½ in. thick, reinforced at the ends by a 12-in. steel channel at the jacking face and a 6x3½-in. angle at the opposite face. Both the channels and the angles are to be welded to the skin-plate. The reinforced-concrete lining will be securely anchored to the deep 12-in. channels of these built-up sections.

The portal sections of the tunnel will be of ordinary cut-and-cover subway type construction.

Interior Similar to Holland Tunnel

In cross-section, the arrangement of the interior of the tunnel will be similar to that of the Holland Tunnel at New York, except that the roadway will be 22 ft. wide instead of 20 ft. The roadway pavement will be of granite block. The fresh-air duct and exhaust duct, together with the inlet and outlet ports, will be placed in much the same position as those in the Holland Tunnel. Also, provision is made in the walls for piping and electric cable conduits. As there will be only one tube instead of two as at New York, traffic will be in opposite directions in the two traffic lanes in the Detroit tunnel. As a depth of 40 ft. over the top of the tunnel across the greater part of the river is required by the War Department, grades up to 4½ per cent are to be used in the tunnel in order to keep the length as short as possible.

Traffic—Two types of traffic are to be handled through the tunnel—one the regular automobile and truck traffic, and the other a regular passenger service between Detroit and Windsor in buses. The latter is to be operated by the tunnel company. It will pick up and deliver passengers in the business section of Detroit and make a turn-around in the terminal area in Windsor. All automobile and truck traffic is subject to customs and immigration inspection at one or the other portal of the tunnel, but as a considerable part of the bus service will be the carriage of regular commuters, two classes of buses are to be operated, one for miscellaneous service which must pass through customs and immigration inspection and the other exclusively for commuter traffic, which will have special permits to pass through the inspection offices without being delayed.

The vehicular tunnel is a private undertaking of the Detroit-Canada Subways, Inc., at an estimated construction cost of $10,000,000. The engineering firm of Parsons, Klapp, Brinckerhoff & Douglas, New York, designed the structures and will supervise construction. Ole Singstad, chief engineer of the Holland Tunnel, is consulting engineer for the engineers and W. S. Kinnear, who was in charge of the construction of the Michigan Central Railway tunnel at Detroit, will represent the owners on the work. Contracts for the shield-driven and the preformed sections of the tunnel have been let to Porter Brothers, of Spokane, and for the remainder of the work, including the cut-and-cover subway construction, the terminals and ventilating structures, contracts have been let to the Parklap Construction Corporation, New York. B. R. Value is supervising engineer and S. A. Thoresen is designing engineer for the engineers on the work at Detroit.

Engineering Literature

A Monthly Review of Books and a Listing of New Publications

Engineer-Nominee for the Presidency

HERBERT HOOVER: A REMINISCENT BIOGRAPHY—By Will Irwin. Cloth; 6x8 in.; pp. 315; halftones. $3.

Thirty-three years ago, at twenty years of age, the man who was nominated at Kansas City last week for President of the United States by one of the major political parties graduated as a mining engineer at Leland Stanford University. Due to his world-wide services since then, as mining engineer, executive and financier, then in charge of Belgian relief, United States food administration during the war, his later relief work in war-stricken Europe, and his seven years as Secretary of Commerce and his recent nomination, Herbert Hoover's career is too well known to need further outline here.

The present biography has advantages over the one by Vernon Kellogg, noted in this section March 17, 1921, of a longer perspective, of covering the intervening time, and of having been written by a college mate at Palo Alto —hence, in part, the subtitle Reminiscent. The story is well told and has strong appeal just now to all classes of people and particularly to engineers who, whatever their political beliefs or affiliations, cannot fail to be interested in the achievement of the first member of their profession to hold a Cabinet office, we believe, and certainly the first engineer to be honored with a nomination for the Presidency of the United States.

Romance Centering on Water Control

WATER! By Albert Payson Terhune. New York and London: Harper & Bros. Cloth; 5x8 in.; pp. 218. $2.

The background of this story is a struggle for possession of a valley and its water rights. The main characters are three men, a girl and—as a matter of course in a story by Mr. Terhune—a collie dog. The hero is a young engineer. The villain is a New York promoter, bent on getting possession of the valley for a large water-supply project, disguised as a land development scheme. The heroine is sister to the third man, a young resident of the valley who is promoting a project for villages and country estates on a series of artificial lakes. High spots in the story are two attempts by the New York promoter to block the rival project by dynamiting a low barrier that, blown away, would divert the main stream from the sites of the lakes proposed by his rivals.

If the author knew as much about water-supply engineering as he does of dogs, he would have written some parts of his book differently, but for the average reader his legal and engineering anomalies will not matter.

The book contains a silly Prologue that lays upon various nationalities of foreign origin the demand for constantly increasing water supplies of the cities in the New York, New Jersey and Connecticut metropolitan area and contains this bit of foolishness: "It occurred to no one to solve the problem forever and at ultimate economy by running a trunk pipe-line from the nearest of the Great Lakes."

There is also a full-page dedication "To the memory of numberless giant forest trees, centuries old, irreplaceable—numberless sweet miles of woodland and meadow —numberless villages once peopled—numberless ancient farmsteads and manor-houses—numberless homelands—all done to shameful death and to shameless burial by the cities' raucous search for water and for more water. Peace to their wistfully smiling ghosts! And God's pity on innumerable others like them; waiting to be butchered and buried in the same unholy name of water."

Fortunately this sort of stuff is reserved for the Dedication and the Prologue, the narrative containing only such references to ruining the countryside to provide water for cities as are essential to the story.

Experiments on Flow of Water in Tunnels

REVIEWED BY L. G. STRAUB
Structural and Hydraulic Engineer, Kansas City, Mo.

WASSERABFLUSS DURCH STOLLEN—By Dr.-Ing. Ernst Schleiermacher. [Investigations in the River Hydraulic Laboratory of the Technical University of Karlsruhe, Germany.] Paper; pp. 60; 31 illustrations. Munich: R. Oldenbourg. 5.50 reichsmarks.

Flow phenomena in tunnels have long been problems to the designing engineer. This is especially true where the inlet and outlet ends of the tunnel are subject to varying heads, as is the case in bypass galleries for hydroelectric plants. The pressure tunnel is usually computed simply as a pipe line, though often not of circular section. However, the case is frequently encountered in which the water level at the exit of the conduit is lower or only a little higher than the crown of the bypass, while simultaneously the head at entrance is high. Such circumstances make possible any of a large variety of conditions within the conduit. For example, especially if an airwell is provided at the inlet end, there is a possibility of "shooting" velocity, with a free water surface. For some relations of friction, slope and headwater and tailwater, a hydraulic jump may occur within the conduit. A. G. Keller, who made experiments on the Mühleberg bypass on the Aar River in Switzerland, found the water to flow with a free surface throughout the length of the tunnel, although the headwater surface was considerably above the crown of the conduit at the inlet and the tailwater level was higher than the crown below the outlet.

Dr. Schleiermacher has investigated these problems in laboratory models. For this purpose he has used both rectangular and circular tunnel sections. The models were built into a glass-sided testing channel so that the phenomena could be observed and photographed.

A knowledge of whether or not the underpressure or contracted section just inside the entrance of the full-flowing tunnel is connected with the atmosphere is of extreme importance, because the water can draw away from the top of the section and flow with a free surface only when air is admitted. The air must be brought through from the tunnel outlet or by connection with an air shaft. Contrary to the assertions sometimes made, it was found that the air drawn through eddies, which form in the headwater, could not alter the flow in the conduit.

The jet form in the aerated tunnel corresponds to the Helmholtz-Kirchhoff theory. Having fixed this point, it is found possible to locate the energy gradient, and

hence the water-surface line and similarly the pressure gradient in the tunnel for arbitrary heights of the headwater and tailwater. The possible conditions of flow within the tunnel are discussed from a theoretical standpoint. Three examples are worked out numerically; two of them indicate the hydraulic jump occurring within the conduit. The method of computation follows the procedure outlined for flow in open channels by Dr. P. Böss.

The author handles well a subject that has thus far received little consideration. It will be worth the attention of those interested in the theory and hydraulic design of water tunnels.

Water, Earth and Air Hygiene

REVIEWED BY A. M. BUSWELL

Chief, Illinois State Water Survey, Urbana, Ill.

DAS ESSENER HEFT—Wanderversammlung des Vereins für Wasser-, Boden- und Lufthygiene, 1927. Berlin-Dahlem, Germany: Landesanstalt für Wasser-, Boden- und Lufthygiene. Pp. 518; illustrations and tables. 12 reichmarks.

The proceedings of the 25th annual convention of the Association for Water, Earth and Air Hygiene, held in Essen in June, 1927, make up the bulk of this volume. Coincident with the convention there was an exposition ("Achema") of chemical apparatus held in Essen under the auspices of the Division for Water Chemistry of the Association of German Chemists (Vereins Deutscher Chemiker). About 55 pages of the volume are given over to a description, profusely illustrated, of the apparatus exhibited at this exposition. The papers cover the entire field of sanitary science from the engineering phases of water supply and waste treatment, the effects of air pollution on human population and vegetation, to the disinfection of clothing and the control of vermin. Several water- and sewage-works are described.

The subjects are all clearly and authoritatively treated, and profusely illustrated. The volume furnishes an exceedingly valuable summary of current practice in the field of sanitation. The questions are naturally discussed from the German standpoint, but references are frequently made to recent progress in other countries. Of the 350 delegates to this convention a considerable number came from foreign countries.

Stress and Strain

BY G. PAASWELL

Consulting Engineer, New York City

DRANG UND ZWANG: Eine Höhere Festigkeitslehre für Ingenieure—By Dr.-Ing. Aug. Föppl and Dr. Ludwig Föppl, Professors an der Techn. Hochschule in München. Zweiter Band, zweite Auflage. Munich and Berlin: R. Oldenbourg. Cloth; 6x9 in.; pp. 382; 79 line cuts.

This book is a second edition of a German book on Stress and Strain. The first edition was prepared by Prof. August Föppl and his son, Prof. Ludwig Föppl. Unfortunately the former died in 1924 and the present text has been prepared by his son. Vol. I was reviewed by the present writer in *Engineering News-Record*, June 19, 1924, p. 1068.

The text is a highly specialized treatment of the applications of the fundamentals of the theory of elasticity to various important problems that confront the designer in unusual structures. As in Vol. I, the text demands an extensive knowledge of mathematics, which unfortunately takes it out of the range of most engineers. The author has gone to great pains, however, to give formulas of practical application and has generally found an approximate method which gives with reasonable accuracy the necessary stresses and strains controlling the design of the structure.

The reviewer yields to no one in his fondness for mathematical analysis, nor does he question the fundamental importance of such analysis in engineering design; but after years of patient endeavor to employ such analysis in descriptions of stress and strain he is compelled to admit that the worth of a piece of engineering research is in inverse proportion to the amount of mathematical content as far as it affects the usual engineering reader. For this reason it is essential in presenting a text of the type under review that the formulas of practical application should be crystallized out of the main text so that those desiring to employ such formulas may find them with ease, even though the analysis upon which such formulas are predicated must be passed over by him. It is a particular merit of this book that such a method of presenting the formulas has been adopted by the author. On the other hand, students of engineering research will find the mathematical analysis given in great lucidity, contrary to the method of presenting such problems in our usual texts by British and American authors.

The first treatment concerns the stresses and strains in membranes which can carry no flexure; the author also gives the criteria for stable and unstable forms of vessels of thin walls.

Torsion is given the most thorough analysis that the reviewer remembers having found in any textbook. Starting with the famous researches of St. Venant, the author has incorporated all research work to the present date and has analyzed practically every section of practical importance. St. Venant gave a general formula for torsion based upon the elliptical section and one which he thought covered the entire realm of engineering sections. The author notes that this formula is entirely too approximate for the rolled sections such as channels, angles and I-beams. He has given formulas which, though approximate, seem sufficiently accurate for the needs of engineers engaged in the design of machine parts and other structures subject to torsion.

The deformation of two bodies in contact, a problem first analyzed by the illustrious mathematical physicist Hertz, is the topic of another chapter, and, although one involving intricate mathematical analysis, gives important results that should prove of value in the study of roller bearings and in machine design in general. The subject is intimately connected with the general theory of hardness and in the use of usual tests to determine the surface hardness. It must be noted, however, that to secure formulas of practical worth approximations must be used which depart far from the general theory as outlined by Hertz. Both the author and his father have done much research work in connection with this subject, and the author has pointed out that in the ordinary run of cases presented to the engineer the theory of Hertz is erroneous. In this connection it may be well worth while noting that the illustrious St. Venant himself attempted the study of this problem and presented formulas which, however, had very little experimental verification.

There is a chapter on the stresses and strains induced in a body by body forces, particularly the effect of heat. The author discusses principally the effect of a general change in temperature throughout the body and has analyzed the resulting deformations in bodies whose boundaries are surfaces of revolution. This would seem to cover well the run of practical problems. The par-

ticular problem of an intense heat applied at one point is one that has so many mathematical difficulties that no attempt is made at its analysis. It would seem, however, that this would be a very important problem for the mechanical engineer. There is a final chapter on the elastic stability of structures, with particular application to buckling. The author analyzes the long, slender column on the basis of several assumptions and derives consistent results. Thus the elastic line may be taken either as a parabola or as a sine curve with closely agreeing results. The Euler formula is derived by several methods. The author takes pains to establish once more a result that apparently few engineers realize—namely, that this famous formula is not fundamentally a column formula but rather a formula giving the criterion of elastic stability.

There is unfortunately a dearth of good illustrations. It is a fault of most European books that little pains are taken to give a figure that is clear and aids the reader in visionalizing the problem under analysis. But this is a secondary point. On the whole, both because of the text itself and because of the numerous references to the latest researches the book should be in the possession of every student of engineering research.

Some Engineering Topics Included

THE ELEMENTS OF ECONOMIC GEOLOGY—By J. W. Gregory, D.Sc., F.R.S., Professor of Geology in the University of Glasgow. New York: E. P. Dutton & Co. Cloth; 5x7 in.; pp. 312. $3.25.

Writing primarily for those concerned with mining, the author deals chiefly with ore deposits and formations, yet includes a few chapters of interest to civil engineers. One of these is devoted to building stones and road metals with respect to durability of different stones, and an analysis of the causes of decay of stones used in construction work, with suggestions for preservation. In a short section on engineering geology, the author deals with water and with coast protection works. The three sources of water are given as meteoric, which is provided by rain; connate, or that inclosed in sedimentary rocks during their deposition, and plutonic, or water from the earth's center. This last source has been doubted by many authorities. The mechanics of wave action on coastal engineering works is strikingly shown. The geology of cements is briefly mentioned. The book closes with chapters on coal and oil deposits.

Correspondence

Literature on Groundwater-Lowering Methods

Sir—In your issue of May 17, 1928, p. 786, there is a review of Gennon book on Groundwater-Lowering Methods, by Dr. W. Sichardt. Permit me to add references to two very valuable previous German contributions on the subject and to give our American reference also.

In 1913 there appeared Grundwassersenkung, by A. Bohlmann, a thesis for a doctor's degree, in which practical applications of the Darcy formula with examples of actual construction were developed. In 1924 there appeared a book by Dr. Schultze on the same subject. A review of this book, by the present writer, was published in your issue of Oct. 16, 1924, p. 638. This book gives in great detail the mathematical derivations of the effect of single and multiple well-points of various combinations and locations with reference to solid walls. It also enumerates a great number of practical applications to engineering construction in Europe.

At a meeting of the Brooklyn Engineers' Club on Nov. 11, 1926, the discussion on a paper on Foundations brought out the fact that this method of lowering groundwater for construction of foundations had been used by several contractors in the construction of sewers in Brooklyn, also in several jobs in Atlantic City.

The literature on the subject, in this country at least, is very meager, and it would be very interesting to hear from men who have had practical experience in the use of well-points.

JACOB FELD,
Consulting Engineer.

New York City,
May 19, 1928.

Publications Received

TIDES AND CURRENTS IN BOSTON HARBOR, by Paul Schureman, mathematician, U. S. Coast and Geodetic Survey, is a 160-p. illustrated addition to the literature on the subject, both general and particular. (30c. from Superintendent of Documents, Washington, D. C.)

AIRPLANE HANGAR CONSTRUCTION is described and illustrated in one of a series of publications entitled Lumber and Its Utilization, being issued by the National Lumber Manufacturers Association, Washington, D. C. (Copies free on application.)

TABLES OF QUANTITIES of materials for concrete gives much valuable information in small compass. It was compiled by the Engineering and Research Division of the National Sand and Gravel Association. (For free copies address the association just named, Munsey Building, Washington, D. C.)

ENGINEERING EDUCATION at Iowa State College, Based on Facts and Opinions of Students and Alumni, has been issued as Bulletin 86, Engineering Experiment Station, Iowa State College, Ames. The study is by Q. C. Ayres, associate professor of agricultural engineering, free on application.

CORROSION RESISTANCE STUDIES, relating to methods of determination, make up a 55-p. pamphlet forming Technologic Paper 367 of the U. S. Bureau of Standards. The authors are H. S. Rawdon and E. C. Groesbeck, senior and associate metallurgists. (20c. from Superintendent of Documents, Washington, D. C.)

TOPOGRAPHIC MAPS OF CHICAGO, including the Evanston, Stockyards, Calumet and Blue Island districts, and also four maps of adjacent outlying territory, all on the 1:24,000 scale, are the latest issues of the topographic survey being made jointly by the U. S. Geological Survey and the Illinois State Geological Survey. (10c. each from M. M. Leighton, chief of Illinois Geological Survey, Urbana, Ill.)

CONCRETE CONSTRUCTION AND FOUNDATION EXCAVATION are two subjects of special interest in the 1927 *Proceedings* of the American Railway Bridge and Building Association. The former covers not only the more routine matters of proportioning, mixing, placing and working the concrete, but also modern developments in the use of quick-hardening concrete and cement hardeners. Devices for taking field samples and making slump tests are described. The excavation report deals with small and large jobs, and with both their equipment and methods. Both reports are followed by discussion. All-the-year-round bridge work and various types of floors for highway bridges are among the other subjects in this volume. ($2, from C. A. Lichty, general inspector, Chicago Northwestern Railway, Chicago.)

SEAWALLS, BULKHEADS AND REVETMENTS built according to the Weber system are discussed in a pamphlet published

by the Shore-Line Builders, Inc., Jacksonville, Fla. The pamphlet is a reprint of a paper by Carl Weber before the annual meeting of the Florida Engineering Society in April of this year. It is illustrated with halftones and line drawings.

CITY AND REGIONAL PLANNING in the United States is again the subject of an annual review by Theodora K. Hubbard, honorary librarian of the American City Planning Institute. The present review covers the year 1927 and extends to 90 pp., is well illustrated, and is reprinted from the April number of *City Planning* (Harvard University, Cambridge, Mass.).

AUTOMOBILE INDUSTRY Facts and Figures for 1928 contains information said to be made available for the first time. Data are given on the major automobile markets, on methods of taxation and gasoline consumption in various states; continental bus routes; list of highways; grade separations; figures on metropolitan traffic. (National Automobile Chamber of Commerce, 66 Madison Ave., New York City.)

THE TRIENNIAL BOOK of A.S.T.M. Standards, dated 1927, is now available in two well-made volumes of 878 and 1,006 pp., dealing respectively with Metals and Non-Metals. Of the 340 standards in the two volumes, 63 relate to steel, nine to wrought iron, and the same number to pig and cast iron, while of Non-Metals there are 48 standards for cement, lime, gypsum and clay products, 31 for preservative coatings, 33 for road materials. ($7 and $9 respectively for either part, in cloth or in half leather, and $14 and $17 for both parts from American Society for Testing Materials, 1315 Spruce St., Philadelphia, Pa.)

IN RESPONSE TO A DEMAND from various public and private quarters for information on the "properties, statistics and manufacture of metals and their alloys," the U. S. Bureau of Standards is collecting and publishing bulletins on the subject. One dealing with aluminum and magnesium under the general classification light metals and alloys is now available in the form of a 402-p. pamphlet containing tables and illustrations. ($1.10 from Superintendent of Documents, Washington, D. C.)

New Books and Revised Editions

[Those desiring copies of the books listed below or mentioned elsewhere in this section should order them from the publishers or from their local booksellers.]

CEMENT, LIMES AND PLASTERS: Their Materials, Manufacture and Properties—By Edwin C. Eckel, C.E., Affiliate, Am.Soc. C.E., Fellow Geological Society of America; formerly Major, Engineers, U. S. A. Third Edition, with Chapter on Alumina Cements and High-Strength Portlands. New York: John Wiley & Sons, Inc. London: Chapman & Hall, Ltd. Cloth; 6x9 in.; pp. 699; 162 illustrations; 269 tables. $7 net.

EARTHQUAKE HAZARDS AND INSURANCE—By Frederick L. Hoffman, LL.D., Consulting Statistician, the Prudential Insurance Company of America; M. Am. Sels. Soc.; Fel. M. Am. Assoc. A.A.Sci., M. Eng. Section, National Research Council; M. Am. Met. Soc., etc. New York and Chicago: The Spectator Co. Cloth; 6x9 in.; pp. 169; $4.

HEALTH AND WEALTH: A Survey of the Economics of World Health—By Dr. Louis I. Dublin, Ph.D., Statistician, Metropolitan Life Insurance Co. New York and London: Harper & Brothers. Cloth; 6x9 in.; pp. 361; some line cuts. $3.

INDIAN STORAGE RESERVOIRS WITH EARTHEN DAMS: Being a Practical Treatise on Their Design and Construction—By William L. Strange, M.Inst.C.E., Chief Engineer in Sind (Retired); author of Irrigation, Roads and Buildings, and Indian Engineering. Third and enlarged edition. 17 plates and 63 illustration. London: George Routledge & Sons, Ltd. Cloth; 6x9 in.; pp. 498; 17 plates and 63 illustrations. Price in England, 25s. net.

JOHN STEVENS: An American Record—By Archibald Douglas Trumbull. New York and London: The Century Co. Cloth; 6x9 in.; pp. 545; 50 illustrations. $5.

POWER CONTROL—By H. S. Raushenbush and Harry W. Laidler. New York: New Republic. Paper; 5x8 in.; pp. 298. $1 postpaid.

SCIENTIFIC PURCHASING: By Edward T. Gushee, Purchasing Agent, the Detroit Edison Co., and L. F. Boffey, Editor, *The Purchasing Agent*, with a Foreword by Alex Dow, President, the Detroit Edison Co., President, Am.Soc.M.E. New York and London: McGraw-Hill Book Co., Inc. Cloth; 6x9 in.; pp. 196; 25 line cuts. $3.

Letters to the Editor

A Forum for Discussion of Views of Engineers and Contractors

The Structural Safety Factor in the St. Francis Dam

Sir—The writer visited the site of the St. Francis dam both during construction and after the failure, and in his opinion the real contributing cause of the failure has not been mentioned or at least has not been fully brought out in any published reports that he has seen so far.

When the writer first visited the site, the dam was approximately 100 ft. high. The poor quality of rock against which the concrete was poured was very apparent and so was the unscientific method used in mixing the concrete. It is rather surprising if the published tests showing a compressive strength of over 2,000 lb. per sq.in. can be actually taken as representing the average strength of the whole structure. It did not occur to the writer that this work was so poor that it was doomed to failure; rather did he feel that perhaps too much excavation was being done on similar work with which he was connected at the time in an adjoining canyon where the rock excavation was overrunning four times the estimated amount, which was very painful for the moment.

Drawings of the dam show that down to El. 1,700 (high-water elevation being at 1,835) the base width is 66⅔ per cent of the height; below this elevation the batter on the downstream face changes in such a way that at the bottom the base width is 82½ per cent of the height.

A concrete dam having a triangular cross-section with a base width equal to 66⅔ per cent of its height is generally called a gravity section. If built straight in plan the resultant force of weight and water pressure will cut the base just inside the downstream middle third point. The average weight of the concrete specimens taken from the dam was 140.6 lb. per cu.ft., which is 8 per cent less than the weight of ordinary good concrete.

The dam was curved in plan, which feature undoubtedly added to its stability during the warm months of the year, but detracted from the stability during the colder months, especially during March, when the temperature of the body very likely would be the absolute minimum for the year. Unless the contraction joints are properly grouted, the arching of the gravity section is detrimental to its stability during the winter months. The area of the upstream face on which the load acts is always larger in a curved dam than in a straight one and the center of gravity of the mass has been moved in a downstream direction. The radial contraction joints are not in contact unless grouted, and although this is being done in isolated instances it has so far not been the accepted practice on gravity dams. Furthermore, in order to have equal safety in all the parts of a gravity structure such as the St. Francis dam, the cross-section must be larger on the side hill, where the dam is, say, 100 ft. high, than in the middle at the same elevation. The crest in the middle deflects considerably (2½ times) more than the crest of the dam where the dam is about one-half the middle height and consequently a transfer of load takes place from the middle section toward the portion of the dam on the hillsides and these portions are then required to take more than their normal share of the load—that is, more than the waterload on the upstream area.

The middle section of the St. Francis dam, taken as whole, had a cross-section possessing a mechanical factor of safety above 2. The portions of the dam on the sides which failed had a mechanical factor of safety of barely 2, if indeed so much, but of much less structurally with reservoir full, since these side portions had to support some load transferred to them automatically from the middle. It would also be most remarkable if this dam section did not have to take care of some uplift. Besides, the dam was arched in plan with the

loaded upstream face longer than the downstream face, since the abutments were practically radial, and the foundation could not withstand tension. The dam was not provided with contraction joints, but cracks had undoubtedly occurred, since an uncracked unreinforced wall of this length (about 700 ft.) is highly improbable.

The cross-section on the side hill above El. 1,700 therefore had a structural factor of safety of less than 1, which was sufficient reason for its prompt failure when the water reached such an elevation that tension was beginning to appear in the upstream face. The concrete very likely could have stood considerable tension, but the poor rock foundation could stand none and began to open up. Then uplift commenced and the section slid down or rolled over. The poor foundation of course was to blame in so far as it could not withstand tension, but there are no facts to show that it was undermined while the structure was still in place. If the foundation had been so unstable, it would undoubtedly have washed out before the water level rose to such a height that the load introduced tension in the upstream face, and that it did not do, although there had been water in the reservoir for a long time. If tension in the upstream face had never appeared, this dam would probably have stood for a long time. The writer has seen only one theoretically tight rock foundation. Some leakage will nearly always have to be tolerated.

The design of the middle portion was such that it should stand even on poor rock; and it did stand, in spite of the punishment it must have received during the flood. This portion taken as a whole has a structural factor of safety above 1. A larger portion than the block now standing, especially toward the east, had a structural factor of safety above 1, but very likely existing natural contraction cracks decided how much should go.

The French and Italian government regulations call for gravity dam sections having decided compression in the upstream face when fully loaded. The sections should also be designed for certain percentages of uplift besides drainage. A section considerably larger than one with a base width of 66½ per cent of the height is required to fulfill these conditions and in view of the St. Francis dam failure it should be clear that the 66½ per cent base width is not conservative for a high straight gravity dam or for an ungrouted gravity arch dam.

San Francisco, Calif., May 29, 1928. LARS R. JORGENSEN, Constant Angle Arch Dam Company.

Deficiencies in Dam Design as Illustrated by the St. Francis Failure

Sir—By way of comment on your excellent report on the St. Francis dam catastrophe, may I express the opinion that the findings of the several engineering committees that the failure was due to defective foundations and that otherwise the design was a proper one will hardly satisfy the public as to the safety of such structures nor will it re-establish confidence in the engineering profession.

I hold strongly to certain tenets as follows: (1) That the failure of the St. Francis dam was due, primarily, to deficiencies in design. (2) That the design used was the result of unwise confidence in a theory now generally applied to masonry dams. (3) That this theory ought to be replaced by more accurate and logical methods of design.

I further aver: (1) That the St. Francis dam slipped on its base as a result of low coefficient of friction in the absence of any other support against sliding. (2) That the kind and quality of the rock, as softened and lubricated by water, was only the immediate cause of this movement. (3) That a mere statement of cause, applying to a structure already built, is not a full and satisfactory explanation of the fundamental reasons productive of a calamity resulting in such terrible loss of life and property.

If this dam had been examined even a day before the failure, what would have been the verdict? Would not it have been said that it was well designed in accordance with the "accepted theory of masonry dams"; that the resultant of all the assumed forces fell within the middle third at a satisfactory angle; and that the loadings on the base were conservative? Would not the dam have been found free from settlement and with only moderate leakage? Would it not have been said that this structure was built as such dams are usually built? Still, at this time the dam was about ready to slip from its foundations! Such a situation can be reasonably explained only by saying that it arose out of professional reliance on a theory and practice either wrong in principle or not sufficiently broad to cover all cases.

I contend that hereafter no masonry dam should be built (1) depending on friction at the base to hold it in place; (2) without deep foundations, so designed as to distribute the load far down into the rock, or (3) without providing, as an integral part of the structure, a definite barrier against unbalanced water pressure acting near the surface. If to these conditions there be added suitable provision for earthquake shock, for local foundation settlement and for inceptive scour, then there is no reason why high dams cannot be built with entire safety on substantially all-rock foundations.

A site for an important dam should never be accepted, of course, save after searching geological, physical and chemical examinations, and I shall add to these requirements a thorough test of the strength of the natural formation by means of air and water pressure applied for a considerable period to deep drill holes. Data from all of these sources are requisite for design.

The failure of the St. Francis dam may be traced in no small degree to overconfidence of the engineers in the infallibility of the "accepted theory of gravity dam design." It is well, therefore, that this theory be now strongly challenged on the ground that it does not at all provide a comprehensive method of determining the fundamental requirements for a safe masonry dam and that it offers only a partial solution of the elementary problem of stability, based on assumptions that are either erroneous or impossible of exact determination. This theory, which omits some of the very essentials of the problem, has, by providing a false sense of security in the minds of those responsible for designs, been one of the chief contributing causes to many failures. It is time that it be replaced by a scientific code of design which will take into consideration all of the forces and all of the factors acting on so important a structure as a masonry dam. It must be admitted by all fair-minded engineers who are familiar with the subject that many dams as designed and built in the past have unjustifiably low factors of safety and that proper provision has not been made to care for hydrostatic pressure acting in the interstices of the rock, nor for partial yielding of foundations, nor for earthquake shocks, nor for other forces that under one condition or another are certain at times to act.

To a certainty, by legislation laymen will curb development in the building of high dams unless the engineering profession is willing to go far beyond the limited pronouncement that this débâcle was due solely to "defective foundations."

M. H. GERRY, JR.

San Francisco, Calif., May 29, 1928.

Smaller Dimensions for Machine Nuts Advised

As the result of a series of tests on standard machine nuts and bolts of bright steel, the British Engineering Standards Association has issued specifications for lightweight nuts intended for use under specially favorable conditions. Nuts of the new standard have a bearing surface approximately equal to the core area of the bolt, so that under stress the elastic limit of the bolt material and of the nut will be reached simultaneously. It is recommended that the smaller-size nuts be used only in clamping together machined surfaces and not on rough cast surfaces. Particular care must be used to secure proper fitting wrenches to avoid crushing the shoulders of the nut. It is claimed that general adoption of the standards will result in a material saving in cost and in weight, in a reduction of the size of pipe flanges in pipe-fitting work and in improved accessibility in confined spaces.

News of the Week

Current Events in the Civil Engineering and Contracting Fields

Water-Works Men in San Francisco Cover Extensive Program

Seventy Papers and Reports Given —William W. Brush Elected 1928-29 President

ABOUT 650 members and guests attended the 48th annual convention of the American Water Works Association at San Francisco, June 11 to 15, and effectively covered a program that included some 70 technical papers and reports. Despite its length the program was not slighted, few papers being read by title and the discussions being more extensive than usual. This was made possible by parallel sessions part of the time and by close attention through meetings extending over five days at which attendance persisted even through the afternoon of the last day.

Outstanding in the business transacted was (1) the abolition of the Standardization Council and the decision to appoint a committee on water-works practice to take over its duties; (2) decision to appoint a committee on constitutional revision and (3) serious consideration of a plan to add to the A.W.W.A. staff a high-grade secretary expressly to serve the technical committees.

PRESIDENT GIBSON OPENS CONVENTION

In opening the convention, President Gibson said that the board of trustees has realized for some time that the constitution has been outgrown. A committee has been at work during the past year planning ways and means of decentralizing, making the governing body more representative and the association generally more efficient. The executive committee has authorized the president to appoint a committee of seven to work out such constitutional revision as best will secure this end. To meet traveling expenses of this committee, $1,500 was added to the annual budget. In view of the probable reference to regional meetings in this new plan, no action was taken on that matter at this time. It was pointed out, however, that there is nothing to prevent two or more sections from holding joint meetings as provided for in the constitution.

The old question of exemption for water-works employees from income tax payment was discussed in detail and stress was laid on the unfairness in exempting municipal employees generally but not men engaged in water departments. Some members who have paid the tax, on advice of counsel, have had it refunded by the government; others who have protested and withheld payment have been required to pay, including interest on back payments. One ruling was that exemption on account of affiliation with fire protection service could be claimed only if account of that service is kept separately and the claimant receives separate payment for that service. The feeling was that the only way to straighten out the situation is to appeal to Congress.

OFFICERS FOR 1928-29 AND NOMINEES FOR 1929-30

Officers for 1928-29 were elected in accordance with the nominating committee report as follows: President, William W. Brush, chief engineer, Department of Water Supply, Gas and Electricity, New York City; vice-president, Jack J. Hinman, Jr., Iowa City, Iowa; treasurer, George C. Gensheimer, secretary, Water Commission, Erie, Pa. The new trustees are C. D. Brown, Walkerville, Canada; Stephen H. Taylor, New Bedford, Mass., and John Chambers, Louisville, Ky.

The following were elected as division officers: Plant Management and Operation, chairman, Harry F. Huy, general manager, Western New York Water Company, Buffalo, N. Y.; Water-Purification Division, Prof. W. F. Langelier, Berkeley, Calif., chairman; Charles C. Hoover, Columbus, Ohio, vice-chairman; and H. E. Jordan, Indianapolis, secretary.

Nominations for association officers for 1929-30 were announced as follows: President, Jack J. Hinman, Jr., Iowa City, Ia.; vice-president, George H. Fenkell, Detroit, Mich.; trustees, J. Walter Ackerman, Watertown, N. Y.; A. F. Porzelius, Chattanooga, Tenn.; W. T. Mayo, Shreveport, La.; treasurer, George C. Gensheimer, incumbent.

ANNUAL AWARDS

The John M. Diven memorial award annually presented to the active member who has rendered the most outstanding service to the association went to W. S. Cramer, chief engineer of the Lexington (Ky.) Water Company.

The Nicholas Hill cup annually

(Continued on p. 986)

St. Louis Engineers to Protect Zoning Plan

The Engineers' Club of St. Louis, which recently acquired a new club building on Lindell Boulevard, is planning to sponsor a protective association to prevent violations of the zoning regulations of the city. This action is being taken not only to protect the club's own property but also because of the interest in maintaining zoning restrictions for the entire city from a general civic standpoint.

California Sewage Association Formed at San Francisco

The California Sewage Works Association was formed in San Francisco on June 11, when 49 men, interested in sewage disposal, met and signed a resolution authorizing an advisory board to proceed with details of organization. The purpose of the association is "to advance knowledge of design, construction, operation and management of sewage-works in the state." It was voted to join the Federation of State Sewage Works Associations, and the advisory board was directed to apply for membership in that body and to appoint two representatives for the federation's board of directors.

The advisory board, named by the resolution, consists of C. G. Gillespie, A. K. Warren, Olin Stewart, A. M. Jensen and Philip Schuyler. This board is to appoint a nominating committee, a committee on bylaws, a membership committee and a program committee. The latter is to prepare a program of papers on sewage-works and sewage disposal to be presented at the first meeting of the association, which will be held at San Bernardino, Calif., on Oct. 8, in conjunction with the annual meeting of the California League of Municipalities.

Chester A. Smith was elected treasurer. Dues are $2 per annum for individual membership, no initiation fee being required. Cities are to be encouraged to take out individual membership for employees engaged in sewage-disposal work.

Constructors to Guarantee Buildings for Five Years

An important innovation in business service has recently been announced by the H. K. Ferguson Company, Cleveland, construction engineers, in declaring a policy of guaranteeing buildings for five years. Beginning June 1, every lump sum contract undertaken by Ferguson engineers on plans and specifications which they have prepared or approved for guarantee will include the following clause: "The builder guarantees the work against defective workmanship and material for a period of five years after date of completion."

Speaking of the new policy, Harold K. Ferguson, president of the company, stated, "We are able to make such a guarantee because we assume complete responsibility for layout and design as well as for the actual construction. When our engineers design a building, put the right materials into it and see that it is constructed soundly, we can be pretty sure it will stand up well."

Regular inspections at least once a year are included in the guarantee and any defects found within the five-year period will be adjusted promptly. Industrial structures are the company's specialty, although it has built a number of office, college and other types of buildings.

Kirk Is Appointed Director of Ohio State Highways

Announcement has been made of the appointment, effective June 15, of Harry J. Kirk as director of the Ohio Department of Highways. The director is appointed by the Governor and is the responsible head of all state highway activities. There is no state highway commission. For the past three years Mr. Kirk has been chief engineer and now succeeds to the position made vacant by the appointment of G. F. Schlesinger a managing director and chief engineer of the National Paving Brick Manufacturers Association.

Mr. Kirk started in the Ohio Department of Highways in December, 1913, in a minor engineering position and was successively promoted to division engineer, maintenance engineer and finally chief engineer. He has been active for several years on committee work of the Mississippi Valley Conference of State Highway Departments, the American Association of State Highway Officials and the Highway Research Board of the National Research Council.

Imperial Valley Dikes Withstand 100,000-Sec.-Ft. Flood

A flood peak of 100,000 sec.-ft. in the Colorado River passed Yuma June 13 without reaching dangerous heights on the levee system, according to a telegram from M. J. Dowd, chief engineer, Imperial Irrigation District. Spring snow reports indicate less water available than last year, therefore high flood this year means low late flow and probable shortage unless there is considerable summer rainfall over the lower watershed. Bed silt content of the water is very high this year due to greater scour and there is much difficulty in maintaining capacity at heads of canals and laterals.

Bids Opened for Owyhee Dam

The bids of seven companies for the construction of the Owyhee dam (*Engineering News-Record* of April 26, 1928, p. 663) of the U. S. Reclamation Bureau in Oregon and Idaho were opened June 7 at Nyssa, Ore. The totals ranged from $3,198,779 to $4,707,365. The estimate of the chief engineer of the Reclamation Bureau was $3,500,000.

Highway Toll Bridges Over Arthur Kill Opened to Traffic

Dedication of the two highway toll bridges across Arthur Kill between Staten Island and New Jersey took place Wednesday, June 20. The bridges are thus opened about 6 months ahead of schedule. The two bridges, the Goethals bridge, between Elizabeth, N. J., and Howland Hook, Staten Island, and the Outerbridge Crossing, between Perth Amboy, N. J., and Tottenville, Staten Island (shown in the accompanying illustration), are similar. Both main spans are cantilever truss structures, while the approaches are deck plate girders.

The bridges were financed by bonds issued by the Port of New York Authority, whose engineering staff designed and supervised construction of the structures. The total length of the Goethals bridge is 7,100 ft. The cantilever is 1,152 ft. long with a 672-ft. center span. The cost of the bridge was $7,000,000. The Outerbridge Crossing is 10,200 ft. long with a cantilever section 1,500 ft. long, using a 750-ft. center span. This bridge is flanked on each end by a 300-ft. through span. The total cost of this bridge was $10,000,000. Both bridges are provided with a four-lane roadway and 5-ft. sidewalks.

The bridges were designed and built by the Port of New York Authority, O. H. Ammann, chief engineer of bridges, and William J. Boucher, engineer of construction. Resident engineers were R. T. Robinson on the Goethals and R. Hoppen, Jr., and A. H. Morrill on the Outerbridge Crossing. Contractors on the projects were: Outerbridge foundations—Frederick Snare Corporation, New York at Tottenville side; Cornell Contracting Corporation, New York, at Perth Amboy side; Goethals foundations—Frederick Snare Corporation, Howland Hook; Triest Contracting Corporation, New York, at Elizabeth; Outerbridge steel superstructure—McClintic-Marshall Company, Pittsburgh; Goethals superstructure — Bethlehem Steel Company, Pittsburgh; Outerbridge plazas—east end, W. H. Gahagan, Inc., Brooklyn, west end, Triest Contracting Corporation; Goethals plazas and deck paving—Albert A. Volk, New York; Outerbridge deck paving—Cornell Contracting Corp.

OUTERBRIDGE CROSSING JOINING STATEN ISLAND, N. Y., TO NEW JERSEY

Two Spans of Colorado River Bridge Carried Out by Flood

Two 190-ft. steel trusses of the highway toll bridge across the Colorado River at Blythe, Calif., were swept away June 14, when a flood of 100,000 sec.-ft. developed two channels that met just above Pier No. 2 on the California side. This was a concrete pier founded on piles, the concrete pier itself being about 70 ft. high. A large amount of drift had accumulated against this pier, causing deep scouring. When the pier gradually settled, both spans slipped into the river, the one nearer the shore remaining partly visible, while the other disappeared entirely. The bridge, which was completed two months ago, consisted of five steel spans of approximately equal length.

Western Society at Annual Meeting Opens New Quarters

Dedication of the new quarters of the Western Society of Engineers in the Engineering Building, Chicago, was made a social function on June 11, with a reception and entertainment, including dancing in the large auditorium. The offices, library, reading and committee rooms and other facilities are on the twelfth floor, while the auditorium is on the second floor, so as to be readily accessible by stairways. This building was described in *Engineering News-Record* of Feb. 16, 1928, p. 270. The social gathering was a preliminary to the annual dinner, held at the Palmer House on June 13, with an attendance of 525 members and guests.

An address by R. W. Putnam, retiring president, reviewed the recent ac-

tivities of the society, the most important being the removal to its new quarters. An active campaign brought in 926 members during the past year, which with nineteen losses by death resulted in a net membership of about 3,200. No awards were made for either the Hunt or Chanute prizes for papers. Apart from this presidential review the principal address was on the proposed Chicago exhibition for 1933, by Charles R. Peterson. Brief talks were made also by H. E. Niesz, for the Chicago Association of Commerce; Pierre Bleouke, American Institute of Architects; Lincoln Bush, American Society of Civil Engineers; W. A. Scheuch, American Institute of Mining Engineers; W. L. Abbott, American Society of Mechanical Engineers, and B. G. Jamieson, American Institute of Electrical Engineers.

Officers for 1928-29 were introduced, as follows: President, John A. Garcia, consulting engineer; vice-presidents, William S. Monroe, D. J. Brumley and W. O. Kurtz; treasurer, Leigh S. Keith; secertary (re-elected), Edgar S. Nethercutt. The technical sections have elected the following as chairmen: Bridge and structural section, O. F. Dalstrom, Chicago & Northwestern Railway; hydraulic, sanitary and municipal section, Arthur E. Gorman, Sanitary District of Chicago; electrical section, Gordon Fox, Freyn Engineering Company; illuminating section, E. R. D'Olive, Commonwealth Edison Company; telegraph, telephone and radio section, H. E. Hershey, Automatic Electric Company; gas section, E. H. Enander, Public Service Company; mechanical section, Frank W. Martin, Sargent & Lundy; railway section, L. G. Curtis, Baltimore & Ohio Chicago Terminal Railroad.

Water-Works Convention

(Continued from p. 984)

awarded to the section making the greatest comparative gain during the year was this year won by the Florida Section, whose membership had been increased 14 per cent. The California Section was mentioned as having added the greatest number of members during the year.

The membership increased last year from 2,403 to 2,442 and a notable further increase has occurred in the last six months, bringing the total as of June 1 up to 2,524. The budget for the coming fiscal year was made $51,500, including the $1,500 for traveling expenses of the constitutional revision committee already noted.

George W. Fuller announced the plan for an International Congress to be held in Tokyo, Japan, Oct. 30, 1929, and on his motion it was voted that the association designate its president, secretary and editor as a committee on publicity and co-operation to further interest in this congress.

A practical field demonstration was given near the hotel to illustrate methods used in making difficult pipe connections as well as jointing and tapping in general. An expert field crew was supplied by the East Bay Water Company for the purpose, and work was done just as in field practice except that the pipes were arranged for display instead of being in trench.

The entertainment program under the direction of a very active local committee with the co-operation of the Water Works Manufacturers' Association, provided for showing the ladies many points of interest around the Bay region during the convention sessions, besides theater and card parties. Wednesday afternoon was left open for the golf tournament, or to accept invitations by the California Division, A.W.W.A., to make one of two automobile excursion trips. One of these, over the San Mateo Peninsula, included the reservoirs of the Spring Valley Water Company, Stanford University and the new pipe line across San Francisco Bay. The other traversed the East Bay cities and the San Pablo and San Leandro filtration plants of the East Bay Water Company. The usual smoker, provided by the Manufacturers' Association, was held on Wednesday evening.

Notes on the Water Works Manufacturers' Association and the exhibits are given on p. 988 of this issue. Abstracts of technical papers and discussions appear, in part, on p. 962 and will be continued in a later issue.

Washington Notes

Provision for Retaining Gen. Potter As Head of Mississippi Commission Held to Conflict With Present Law

By Paul Wooton
Washington Correspondent

IN CONNECTION with the relief of Gen. Charles L. Potter as president of the Mississippi River Commission, it has been learned that the President had legal advice that the continuation of General Potter in the service would conflict with an existing statute which precludes the use of officers beyond the retirement age in the military establishment during peace. While it was the intention of the framers of the flood-control act to set aside this statute in the case of General Potter, the language of the act, in the opinion of some authorities at least, is inadequate for that purpose.

The board of three set up by the flood-control act, consisting of Major Gen. Edgar Jadwin, Brigadier Gen. Thomas H. Jackson and Carleton W. Sturtevant, is meeting in St. Louis this week to organize and formulate plans for the study of the engineering differences between the plans of the Army engineers and those of the Mississippi River Commission. Following the meeting the members of the board will make a trip down the river for the purpose of holding public hearings and looking over the areas involved. They expect to reach an early decision as to the extent of the surveys which will be necessary, so that they may go forward promptly.

Gen. Thomas H. Jackson New Head of Mississippi River Commission

Thomas H. Jackson, brigadier general, Corps of Engineers, U. S. Army, whose appointment to be president of the Mississippi River Commission was announced in the news pages of last week's issue, gained his experience in river-control work on the Sacramento River, in California, first in 1907, and then again in the past two years, he having been a member of the California Débris Commission at the time of his appointment to the Mississippi River Commission.

General Jackson was born in Westmeath, Ont., in 1874, and entered the U. S. Military Academy from Michigan in 1895. Upon graduation, in 1899, he was commissioned a second lieutenant in

Brig.-Gen. T. H. Jackson

the Corps of Engineers and sent to take charge of fortification work at Cushing Island, Portland, Me., for two years. From there he went to the U. S. Engineer School of Application as a student officer for two years and then to Washington Barracks on seawall construction. In 1903 he was sent to the Philippine Islands as engineer officer of the Department of Visayas, subsequently taking over the charge of certain construction work at Fort William McKinley.

Upon his return to the United States in 1905 he served at Fort Riley and at Fort Leavenworth, Kan., until, in 1907, he was appointed member, secretary and disbursing officer of the California Débris Commission, which work included flood control on the Sacramento and Feather rivers. After four years on this work, Captain Jackson was ordered to Dallas, Tex., to take charge of the engineering district there, a post which he occupied until 1914, when he went to Wheeling, W. Va., for work on the Ohio River.

Soon after the United States entered the war he was ordered to Madison Barracks, N. Y., as senior instructor in engineering at the first officers' training camp held at that post. In July, 1917, he

left for France, where he served first as an assistant to the chief engineer, lines of communications, and then as engineer purchasing officer. After the armistice Colonel Jackson was placed upon the liquidation commission, for which work he was awarded the Distinguished Service Medal (United States) and was made an officer of the Legion of Honor (France).

Following his return to the United States in November, 1919, Colonel Jackson was first at Washington for about a year, then commanded the Twelfth Engineers at Camp Grant, Ill., and subsequently served as instructor to the Missouri National Guard at Kansas City. In November, 1922, he was ordered to San Francisco to become corps area engineer of the Ninth Corps Area, which position he occupied until the latter part of 1926, when he was appointed division engineer of the Pacific Division and a member of the California Débris Commission.

Colonel Jackson stands next to last upon the list of colonels of the Corps of Engineers. His appointment to the presidency of the Mississippi River Commission carries with it the rank of brigadier general.

Personal Notes

Brigadier Gen. CHARLES L. POTTER, formerly president of the Mississippi River Commission, has been placed upon the brigadier generals' retired list of the army and relieved from duty as a member of the new Mississippi River Commission.

Dr. HARVEY NATHANIEL DAVIS, president-elect of Stevens Institute of Technology, was honored by Brown University with the degree of Doctor of Science at the 160th annual commencement on June 18. Dr. Davis was graduated from Brown in 1901.

W. K. HATT, professor of civil engineering of Purdue University, Lafayette, Ind., has been designated by the president of the American Railway Engineering Association to represent that association at the opening of the new library at the University of Louvain at Louvain, Belgium, on July 4, and will sail shortly for Europe.

GEORGE H. PEGRAM, of New York City, chief engineer of the Manhattan Elevated Railroad, the Interborough Rapid Transit Company and the Rapid Transit Subway Construction Company, received the honorary degree of Doctor of Laws at the recent commencement exercises at Washington University, St. Louis, from the school of engineering of which institution Mr. Pegram was graduated in 1877 at the head of his class.

C. A. WILMORE, B. S. MERRILL and E. M. HODGES announce the formation of the engineering corporation in Birmingham, Ala., of C. A. Wilmore & Associates, Inc., prepared to furnish designs, details or supervision of structural steel, reinforced-concrete or timber structures, estimates on engineering projects or to act as consulting engineers. Mr. Wilmore, a graduate of Auburn University, has for the last six years been district manager in Birmingham for the Nashville Bridge Company. Mr. Merrill is a graduate of Rutgers College and has been practicing as consulting engineer in New Orleans for the last year and a half and for eight years previously was structural engineer with Favrot & Livaudais, of that city. Mr. Hodges has been with Gardner & Howe, Memphis, Tenn., for the last six years.

Prof. HAROLD WARD GARDNER, head of the department of civil engineering at the Colorado School of Mines, Golden, has received the degree of Bachelor of Law at the Westminister Law School of Denver. Professor Gardner won his law degree by attending the night sessions of the law school for three years. He has not as yet announced whether he will take to the law or stick to engineering.

DONALD F. HORTON has been transferred from the secretary's office, Mississippi River Commission, to the Cape Cod Canal, where he will be assistant to the engineer in charge of maintenance. Mr. Horton is a graduate of the Massachusetts Institute of Technology.

ROBERT L. SPENCER, chief engineer of the McAleenan Corporation, Pittsburgh, Pa., has been elected dean of engineering of the University of Delaware. Mr. Spencer, before his industrial work, was for eight years professor of mechanical engineering at Lehigh University and for a time instructor at Iowa State College.

ARTHUR E. HALL, structural engineer, of Detroit, Mich., has taken a position with Arthur G. McKee & Company, of Cleveland, Ohio, who have extensive contracts in Canada and Europe. Mr. Hall recently had charge of the design of alterations to the power plant of the Packard Motor Car Company in Detroit.

Major R. T. COINER, who has been on duty in the office of the Assistant Chief of Engineers, handling power and flood-control matters, has been ordered to Fort Humphreys for duty at the engineers' school, where he will lecture on river and harbor engineering.

HERBERT C. SADLER has been appointed dean of the colleges of engineering and architecture of the University of Michigan, effective July 1. Professor Sadler has been on the Michigan faculty since 1900.

RAYMOND E. DUFF, Cleveland, Ohio, has been engaged by Brown & Cook, engineers, of Ottumwa, Iowa. He will act as resident engineer on municipal construction work in various parts of the state. Mr. Duff is a graduate of Ohio Northern University and was formerly employed as engineer for the department of finance of the city of Cleveland, where he appraised benefits on public improvements.

Engineering Societies

Calendar

Annual Meetings

SOCIETY FOR THE PROMOTION OF ENGINEERING EDUCATION; Annual Meeting, University of North Carolina, June 25.

AMERICAN INSTITUTE OF QUANTITY SURVEYORS, Chicago; Annual Convention, New York, June 25-27.

AMERICAN SOCIETY FOR TESTING MATERIALS, Philadelphia; Annual Meeting, Atlantic City, June 25-29.

AMERICAN SOCIETY OF CIVIL ENGINEERS; Annual Convention, Buffalo, N. Y., July 18-20.

NEW ENGLAND WATER WORKS ASSOCIATION, Boston, Mass.; Annual Convention, Montreal, Canada, Sept. 18-21.

AMERICAN SOCIETY FOR MUNICIPAL IMPROVEMENTS, St. Louis, Mo.; Annual Convention, Detroit, Mich., Oct. 22-28.

THE WASHINGTON CHAPTER OF THE AMERICAN ASSOCIATION OF ENGINEERS re-elected Edgar B. Kay president at its recent annual election meeting. Others elected were: Nolan D. Mitchell, first vice-president; Morton G. Lloyd, second vice-president; Henry W. Austin, corresponding secretary; Isaac Tepper, recording secretary; and Hugh D. Dollins, treasurer. A committee was appointed to study a plan which has been formulated to be submitted to Congress for a ten-year $100,000,000 building program for the District of Columbia.

THE NEW ENGLAND WATER WORKS ASSOCIATION nominating committee has submitted the following list of nominees: President, Arthur D. Weston, Boston, Mass.; vice-president, George H. Finneran, Boston; treasurer, Albert L. Sawyer, Haverhill, Mass. The association, in conjunction with the Boston Society of Engineers, will hold its annual outing on June 26 at Swampscott, Mass.

THE AMERICAN SOCIETY OF HEATING AND VENTILATING ENGINEERS will hold its 34th semi-annual meeting in West Baden, Ind., June 26-29.

THE INTERNATIONAL ASSOCIATION OF STREET SANITATION OFFICIALS will hold its ninth annual conference in Toronto, Canada, Oct. 8-9.

THE ENGINEERING INSTITUTE OF CANADA, Montreal and Ottawa branches, recently sponsored a steamer excursion along the St. Lawrence from Montreal to Brockville, Ont. The purpose of the tour was to make a first-hand study and inspection of the problems of the St. Lawrence waterways.

THE ROCHESTER ENGINEERING SOCIETY held its annual meeting on June 8 and elected H. H. Sullivan president. The secretary's report showed that 35 new members had been added during the year.

Construction Equipment and Materials

A Section Devoted to What the Manufacturer Is Doing for the Engineer and Contractor

Water-Works Equipment at San Francisco

Seventy-eight Companies Exhibit at Convention of American Water Works Association

THE fact that no meeting of the American Water Works Association had ever been held farther west than Denver did not keep the manufacturers of equipment used in the water-works field from putting on a good show at the convention last week in San Francisco. Although the display lacked some ten or twelve exhibits of equaling the record, there were 78 manufacturers showing such diverse equipment as chemicals, chlorination equipment, filtration equipment, meters, pipe, pumps and well apparatus, steel tanks, valves, hydrants, and repair and testing equipment.

J. R. Barker, of the San Francisco office of the Neptune Meter Company, was in charge of the exhibits.

Lack of space precludes mention of all except those exhibits which included the newest and most novel types of equipment. The Asphalto Concrete Corporation showed a concrete pipe lined with an asphalt and clinker combination for which special waterproofing and wear characteristics are claimed. The American Cast Iron Pipe Company, besides its mono-cast-centrifugal cast-iron pipe, showed a Victaulic joint made up to demonstrate how it could be used with regular cast-iron pipe and also exhibited some examples of bronze welding of cast-iron pipe lengths. Builders Iron Foundry, in addition to its various sizes of Venturi meters, exhibited a new direct-acting controller and a new shunt steam meter for use in steam power plants. The Dorr Company showed a 6-ft. working model of its traction clarifier similar to the ones used in the new water-works plants at Kansas City and at St. Louis for the presedimentation of turbid waters ahead of coagulation basins. The McWane Cast Iron Pipe Company featured the company's new process of manufacturing cast-iron pipe horizontally with the aid of mechanically prepared cores and molds. The National Tube Company showed the Talbot-lined steel pipe, the American rights for which it recently acquired. The Pomona Manufacturing Company exhibited a full-size well pump in operation throwing a 6-in. stream. The Everlasting Paint & Sales Company, Los Angeles, Calif., exhibited sections of pipe coated with "McEverlast," which has a base of Trinidad Lake Asphalt and gilsonite. This material is applied cold, by means of a canvas sling.

Following is a list of the exhibitors, classified according to type of equipment shown:

Brass Goods—American Brass Co., Jas. Jones Brass Co., Republic Brass Co.

Chemicals—La Motte Chemical Products Co.

Chlorination Equipment—Paradon Manufacturing Co., Wallace & Tiernan Co.

Construction Equipment—Barber-Greene Co.

Filtration Equipment—Builders Iron Foundry, California Filter Co., The Dorr Co., International Filter Co., National Aluminate Corp.

Joint Materials—Hydraulic Development Co., Leadite Co.

Meter Boxes—Art Concrete Works, Builders Iron Foundry, Ford Meter Box Co.

Meters—Badger Meter Mfg. Co., Federal Meter Corp., Gamon Meter Co., Hersey Mfg. Co., National Meter Co., Neptune Meter Co., Pittsburgh Equitable Meter Co., Simplex Valve & Meter Co., Thomson Adriance, Inc., Thomson Meter Corp.

Pipe—Asphalto Concrete Co., American C. I. Pipe Co., Bent Concrete Pipe Co., Central Foundry Co., Lead Lined Iron Pipe Co., Lock Joint Pipe Co., McWane Cast Iron Pipe Co., Montague Pipe & Steel Co., National Tube Co., B. Nicoll & Co., Pacific States C. I. Pipe Co., Victaulic Co. of America, U. S. Cast Iron Pipe & Fdry. Co., Western Concrete Pipe Co., Western Pipe & Steel Co., R. D. Wood & Co.

Pipe Coatings—Everlasting Paint & Sales Co., Wailes-Dove-Hermiston Corp.

Publications—American City, Construction Methods, Engineering News-Record, Public Works, Gillett Pub. Co., Waterworks Engineering, Western Construction News.

Pumps and Well Apparatus—DeLaval Steam Turbine Co., Fairbanks Morse & Co., Byron Jackson Pump Co., Kimball Pump Co., Layne & Bowler Co., Pomona Mfg. Co., Worthington Pump & Machy. Corp.

Repair—Giant Mfg. Co., National Water Main Cleaning Co., A. P. Smith Mfg. Co., Rex Tapping Machine Co.

Steel Tanks—Chicago Bridge & Iron Works, Pittsburgh-Des Moines Steel Co.

Testing Service and Surveys—Pitometer Co.

Valves, Fittings and Hydrants—Automatic Cone Valve Co., Columbian Iron Works, Kennedy Valve Co., Michigan Valve & Fdry. Co., Mueller Co., Rensselaer Valve Co., Ross Valve Mfg. Co., A. P. Smith Mfg. Co.

Unclassified—Burroughs Adding Machine Co., California Corrugated Culvert Co., Forni Mfg. Co., Greenberg & Sons Co., Hydraulic Engineering Co., Linde Air Products Co., Mabbs Co., Rich Steel Products, Shand & Jurs Co., R. W. Sparling, Waterworks Supply Co.

National Slag Association Re-elects Officers

At the eleventh annual meeting of the National Slag Association, which was held at the offices of the association in the Leader Building, Cleveland, Ohio, June 8, the following officers were re-elected for the ensuing year: C. L. McKenzie, Duquesne Slag Products Company, Pittsburgh, Pa., president; C. E. Ireland, Birmingham Slag Company, Birmingham, Ala., vice-president; H. J. Love, 937 Leader Building, Cleveland, Ohio, secretary-treasurer.

Water Works Manufacturers Elect Officers

Officers of the Water Works Manufacturers' Association were elected as follows: President (to take office Jan. 1, 1929), Rollo E. Blanchard, Neptune Meter Company; vice-president, William E. Sherwood, Hersey Manufacturing Company; treasurer, Arthur E. Buttenheim (incumbent), and secretary, John A. Kienle (incumbent). Members of the Manufacturers' Association executive committee were elected as follows: *American City*, Pittsburgh-Des Moines Steel Company, *Engineering News-Record*, Wallace & Tiernan Company, Inc., and the Pittsburgh Equitable Meter Company.

Concrete Road Yardage

There is given below a tabulation of concrete pavement yardage awarded during May, 1928, together with the total number of square yards awarded for the year to June 2, 1928, as prepared by the Portland Cement Association. The figures represent awards in the United States only:

	Sq. Yd. Awarded During May, 1928	Sq. Yd. Awarded From Jan. 1, 1928, to June 2, 1928
Roads	13,245,577	44,432,228
Streets	6,961,013	18,641,153
Alleys	488,334	1,216,127
Totals	20,694,924	64,289,508

Business Notes

THOMAS F. EGAN, for many years associated with the Eastern sales office of the Pacific Tank & Pipe Company, is now Eastern sales manager of the technical division of the Little River Redwood Company, 103 Park Ave., New York City.

NORTHERN CONVEYOR & MANUFACTURING COMPANY, Janesville, Wis., announces that patents have recently been granted it covering the combined use of shaker screens and portable conveyors.

MASSACHUSETTS INSTITUTE OF TECHNOLOGY, department of building construction, is desirous of obtaining catalogs, bulletins, data and trade literature on all of the phases of building construction and materials in order to build up a catalog file for reference. Such literature would be appreciated if mailed to Prof. Walter C. Voss, Old Town Road, Wellesley Farms, Mass.

CHAIN BELT COMPANY, Milwaukee, announces the appointment of Charles H. Upson, formerly district manager for the Dodge Manufacturing Company, as its representative in the Cincinnati territory, with offices in the Traction Building, Cincinnati.

E. I. DU PONT DE NEMOURS & COMPANY, Wilmington, Del., announces that Joseph Lang, Wilmington, Del., who has represented the company in the New York territory for the past 40 years, has been relieved of whatever duties he may desire to relinquish and that these will be taken over by R. H. Nicol, one of the company's senior representatives. Mr. Lang, if his health permits, will call on his customers as in the past. Mr. Nicol has been in the

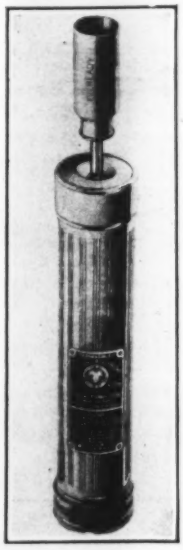
organization for 25 years and thus is well equipped to carry on the work of Mr. Lang, according to T. E. Doremus, manager of the New York explosives office of the company.

BAY CITY DREDGE WORKS, Bay City, Mich., announces appointment of distributors as follows: Roy Baker, 2816 Braxos St., Houston, Tex.; Lone Star Road Mach'y Co., 2003 So. Akard St., Dallas, Tex.; Tobin Mach'y & Supply Co., 705-06 Builders Exchange, San Antonio, Tex.; Hooper Equipment Co., 224 North Alabama St., Indianapolis, Ind.; New England Implement Co., 19 Jersey St., Boston, Mass.; McWhorter Tractor & Equip. Co., 300 W. Main St., Chattanooga, Tenn.; Gale A. Goss, Durand, Wis.; Zimmerman-Wells-Brown Co., Portland, Ore.; Olympic Machinery Co., 134 Intern. Right-of-Way, Spokane, Wash.; Star Machinery Co., 1731 First Ave., So., Seattle, Wash.; Midwest Machinery Co., 1629 Seventh St., Des Moines, Iowa.

New Developments

Dry Cell Blasting Unit Provides Advantages of Electric Firing

The danger of misfires or delayed fires from fuse troubles in individual blasting is claimed to be eliminated by the single shot firing unit introduced recently by the National Carbon Company, 30 East 42nd St., New York City.



The unit draws its current from a dry battery cell, contained in a compact lightweight cylinder. It is patterned after the tubular flashlights produced by the same company, even to a ring hanger on the bottom cap for carrying on one's belt or hanging from a hook on the wall. The ring hanger, when not in use, snaps over the bottom cap. The unit contains three standard flashlight batteries, whose life is claimed to be good for 100 shots.

Wires leading from the cap are fastened to a special plug. To fire the blast it is necessary to insert this plug in a small socket in the end of the device and hold it there with pressure against a spring inside. As soon as one's hand is released, the plug is disconnected. A piece of wire is run through three holes in the end of the tube, the ends of the wire being sealed with a lead seal. Insulated rubber-covered copper wire is connected with an electric cap which is inserted in a cartridge at the blasting point, the other end of the wire being connected to the plug contact.

Ratchet-Jack Legs for Erecting Portable Batching Plant

A 100-ton portable concrete proportioning plant has been developed by the Madsen Iron Works, Huntington Park, Los Angeles, Calif., in which are used several new details of design. The entire plant, consisting of bin and combination volume and weighing batcher,

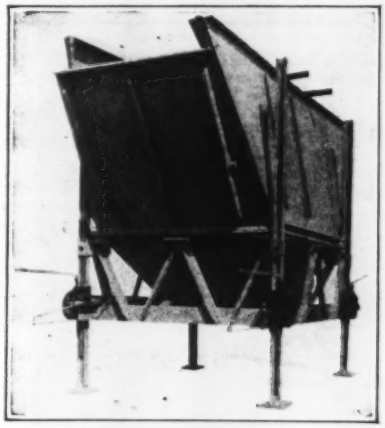


FIG. 1—AGGREGATE BIN ERECTED BY JACK LEGS

is constructed of steel. It is said that it can be transported on a 5-ton truck. One of its principal features is the use of jacks built into the frame by means of which the bin is raised and lowered, thus eliminating the necessity for gin poles, hoists or cranes.

The bin proper is semi-collapsible, the flared sides being hinged so that they may be folded in during transportation. The bin is mounted on an I-beam platform, which is in turn supported on six rigidly braced H-beam columns. The jacks are placed in four of the columns, while the two extra columns are bolted in after the bin is raised.

The batch box is adjustable and can be used for both volume and weight proportioning. The rock compartment is calibrated from 10 to 26 cu.ft., and the sand compartment from 5 to 16 cu.ft. It is suspended under the lateral cut-off gate on the bin bottom, either directly when used for volumetric measure or on four-point suspension five-to-one knife-hardened scale beams when used for weight proportioning. All the controls are bunched together close to the scale dial for ease of operation.

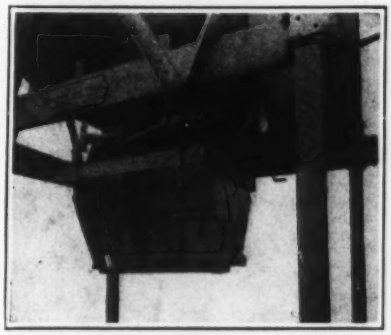


FIG. 2—AGGREGATE BATCHER FOR VOLUME OR WEIGHT PROPORTIONING

Manufacturers and Trade Associations

Calendar

Annual Meetings

TRACK SUPPLY ASSOCIATION, Chicago; annual exhibition and convention, Detroit, Sept. 18-20, 1928.

New Publications

Guniting—GUNITE CONCRETE & CONSTRUCTION COMPANY, Kansas City, Mo., has published a 32-p. booklet entitled "Cement-Gun Shots," which is largely devoted to illustrations of important jobs on which this company has used its guniting equipment and ability. These jobs include structural steel incasements, tunnel linings, revetment and bank protection, roof and residence covering, reservoir lining and sewer lining. There are also included a number of letters received from satisfied clients of the company, together with information blanks which can be sent to the company when contemplating guniting work.

Material Tables for Concrete—NATIONAL SAND AND GRAVEL ASSOCIATION, INC., Washington, D. C., has devoted its Bulletin No. 4 to "Tables of Quantities of Materials for Concrete." In the association's Bulletin No. 1, "Estimating Quantities of Materials for Concrete," there are outlined the fundamental principles on which the tables in this Bulletin No. 4 are based. Bulletin No. 4 contains ten tables and in addition an explanation and several typical problems, so that it can be quickly and readily used with practical results.

Liquid-Level Gages—THE BRISTOL COMPANY, Waterbury, Conn., devotes a 31-page catalog, No. 1800, to its recording liquid-level gages used particularly in water-works, hydro-electric and sewage-disposal plants. Illustrations of the various apparatus included in the different type systems, together with descriptions and diagrams of a few methods of installation, are included, as well as examples of the various types of charts used with the recording machines.

Tractor Shovels—BAY CITY DREDGE WORKS, Bay City, Mich., devotes its Bulletin No. 4 to its tractor shovel. The bulletin contains letters of commendation from numbers of users, illustrates and describes the various important mechanical features of the machine, and gives operating diagrams showing capacities and ranges.

Business Side of Construction

Facts and Events That Affect Cost and Volume

Industrial Building Maintains Lead Over 1927

Contracts for industrial building construction in the first five months of this year total $124,693,000, compared with $97,947,000 in the same period of 1927. There were 599 of these contracts, compared with 575 last year. The average value of the 1928 job is $208,158, against $170,342 in 1927. The accompanying table breaks down these figures into 28 classes or industries. The public utilities group is the leader with 53 jobs valued at $23,000,000, which is almost the exact figure for 1927.

It is seen that the expansion of plants has been quite general, with large increases in the following lines: Paper and pulp, heavy chemicals, manufactured gas, rayon, glass, automotive and refrigeration. All sections of the country, except the Far West, shared in this increased activity in industrial building. Very substantial gains were recorded in New England, the Middle Atlantic States, the South and the region between the Mississippi and the Rocky Mountains.

Foreign Construction Opportunities

A project is reported to have been submitted to the Spanish government to connect Spain with Africa by a tunnel under the Strait of Gibraltar, according to *Commerce Reports*. Additional details are available under reference France No. 67724. A plan to reconstruct an area in the center of the business section of Bradford, England, at an estimated total cost of nearly $10,000,000 is under consideration, and a portion of the program to the value of $1,000,000 has been authorized. The government of Angola is endeavoring to negotiate a loan for use in initiating and continuing certain public works that had been planned for construction in 1927. The most important project is the continuation of work on the Loanda and Lobito port works. Additional information is available under reference Angola No. 277093.

The government of the Dominican Republic is endeavoring to determine what further expenditures toward completing its irrigation projects are warranted. The sum of $645,000 was allotted for irrigation purposes, of which $575,000 had been expended up to March 31, 1928. Completion of the Santiago irrigation project will probably call for further expenditure of not less than $500,000. The Bani project will probably need $1,000,000 if carried to completion.

E. N.-R. Index Numbers

Cost		Volume	
June 1, 1928	**206.15**	**May, 1928**	**299**
May 1, 1928	207.00	April, 1928	316
June 1, 1927	205.55	May, 1927	299
Average, 1927	206.24	Average, 1927	263
Average, 1926	208.03	Average, 1926	228
1913	100.00	1913	100

INDUSTRIAL BUILDING CONTRACTS OF $40,000 AND UP AWARDED IN THE U. S.

	—Total Jan. 1 to June 1— 1928	1927
Food Products:		
Value	$13,445,000	$11,995,000
Number	74	84
Textiles:		
Value	3,213,000	2,183,000
Number	24	22
Iron and Steel Products:		
Value	4,616,000	7,133,000
Number	31	49
Leather:		
Value	336,000	199,000
Number	6	3
Rubber Products:		
Value	965,000	943,000
Number	4	7
Paper and Pulp:		
Value	5,880,000	808,000
Number	10	5
Heavy Chemicals:		
Value	3,120,000	945,000
Number	14	6
Fine Chemicals:		
Value	625,000	479,000
Number	4	3
Coke:		
Value	100,000	.....
Number	1	.....
Manufactured Gas:		
Value	8,100,000	985,000
Number	2	7
Oils, Veg., Animal		
Value	56,000	350,000
Number	1	2
Paints, Varnishes:		
Value	650,000	435,000
Number	8	4
Petroleum Refining:		
Value	1,462,000	3,859,000
Number	8	18
Rayon:		
Value	10,040,000	.....
Number	2	.....
Soap:		
Value	140,000	410,000
Number	1	3
Other Process Ind.:		
Value	2,853,000	2,094,000
Number	11	11
Lime and Cement:		
Value	234,000	1,021,000
Number	2	7
Clay and Brick Products:		
Value	749,000	1,470,000
Number	5	8
Glass:		
Value	2,140,000	425,000
Number	3	4
Public Utilities:		
Value	23,073,000	24,384,000
Number	53	49
Automotive and Garages:		
Value	12,472,000	5,802,000
Number	81	64
Machine Shops:		
Value	3,056,000	3,121,000
Number	20	27
Printing and Binding:		
Value	2,652,000	1,508,000
Number	12	13
Foundries:		
Value	701,000	1,752,000
Number	9	11
Refrigeration:		
Value	4,976,000	3,283,000
Number	10	13
Lumber, Woodworking:		
Value	900,000	1,059,000
Number	8	10
Warehouse:		
Value	5,850,000	7,939,000
Number	25	20
Unclassified:		
Value	12,289,000	13,365,000
Number	170	125
Total:		
Value	$124,693,000	$97,947,000
Number	599	575

Business Notes

Sales of asphalt and asphalting materials manufactured from petroleum totaled 3,951,450 tons in 1927, an increase of 14 per cent over 1926. Of the total 1927 sales, 39 per cent is reported by the Department of Commerce to have been produced from domestic crude petroleum and 61 per cent from foreign petroleum. The average value in 1927 was $13.87 per ton, compared with $13.46 in 1926. Paving asphalt of the solid and semi-solid class comprised 42 per cent of the output. The roofing and waterproofing branch of the industry used more than 1,000,000 tons.

An investigation of unemployment has been authorized by the Senate. The committee on education and labor of the Senate will study the causes of unemployment and the relation of its relief to the continuous collection and interpretation of adequate statistics of employment and unemployment, to the organization of systems of public employment agencies, to the establishment of unemployment insurance, to the curtailing of production, to consolidation and economic reconstruction, to the planning of public works with regard to stabilization of employment, and to the feasibility of co-operation with federal, state and private agencies. The report of the committee is to be made on or before Feb. 15, 1929.

Consumption of electrical energy by 3,000 large manufacturing plants in May was 0.2 per cent under the April rate and 1.3 per cent under that of a year ago. This is the first time since last September that industrial activity, as measured by consumption of electrical energy, dropped below that of the same month in the year previous, according to *Electrical World*. May was the peak month in 1927. This year the peak was in February.

The only two centers reporting May sales of machine tools below those of April were Detroit and New York. Unexpected business strengthened sagging markets in both cities. In Detroit, says the *American Machinist*, Ford activity is affecting many lines, since a large number of parts orders are being farmed out, some to distant places. Automotive production for several other companies is still being maintained at a high rate.

This Week's Contracts

Heavy construction contracts, reported by *Engineering News-Record* in the week ended June 21, with some comparisons, total as follows:

(In Thousands of Dollars, 000 Omitted)

Week Ended	Public	Private	Total
June 21, 1928	**$28,738**	**$28,743**	**$57,481**
June 14, 1928	14,767	13,036	47,803
June 23, 1927	38,636	34,406	73,042
Jan. 1 to date:			
1928	620,506	999,729	1,620,635
1927	579,161	860,269	1,439,430